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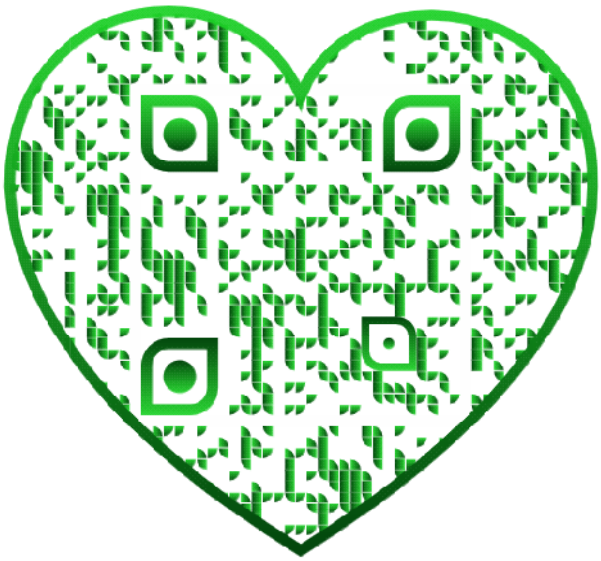

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BIG-INCH BIG-BLOCK CAM SWAP + HUGE HORSEPOWER
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1972 NOVA SUSPENSION UPGRADE

## ON THE COVER

Jesus Lopez and the crew at Lopez Performance teamed up with designer Sean Smith to create a stunning 1969 Camaro for JR and Celeste Villarreal, showcasing extraordinary design and next-level craftsmanship. The result is nothing short of spectacular, and we are proud to feature it on the cover of your Jan. '25 issue. Be sure to read the full story starting on page 16. Image by Wes Allison.

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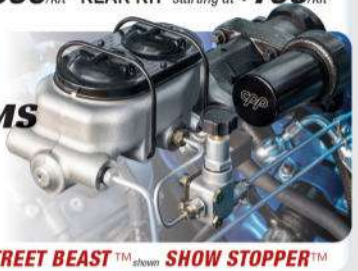

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BY **NICK LICATA**

# HAPPY NEW YEAR AND HAPPY FOURTH ANNIVERSARY!

The January issue of *All Chevy Performance* is always special for two reasons: one, it's the first issue of the year and it gives us the feeling of a fresh start to the new year without having to make any New Year's resolutions. Although, I suppose we could come up with some cockamamie idea … yeah, no. The second reason is that January marks the month of this magazine's first issue back in 2021, so it represents a yearly milestone the staff and I are very proud of. With that said, we celebrate the January 2025 issue as it marks our fourth year producing *All Chevy Performance* magazine.

I've been fortunate to have been at the helm of this publication from the "are-we-really-doing-this" phase to seeing the very first issue come to life, which was very exciting. Like they say, "time flies when you are having fun," and the last four years seem to have flown by.

Today, most of the legacy automotive print magazines many of us grew up with are all but gone or are no longer printed on a monthly basis due to various reasons. That right there would tell most sane people that starting a new print magazine from the ground up is probably not a great idea, but in our eyes the lack of success with other print magazines wasn't so much the content or subject matter but was how that content was delivered. Over the years, large publishing companies gradually cut back on paper quality and the number of pages in the magazines—all in the name of saving money. Even the physical size of the magazines gradually began to shrink hoping the readers wouldn't notice–but you did. These cost-cutting measures made the reader feel they were no longer getting their money's worth, so they stopped re-upping their subscriptions and buying the magazine off the newsstands.

So, we came up with the crazy idea that if we put together a magazine with lots of pages on thick, high-quality, glossy paper similar to what was used back in the 1960s and 1970s, we'd be onto something. Well, that crazy idea worked, and four years later we are still pumping out 12 issues a year of the best and only monthly magazine dedicated to Chevy muscle cars. That doesn't mean we aren't crazy–it just means our idea of how to do print works with your way of reading and enjoying print.

So, as we celebrate our first issue of 2025, we'd like to wish you a happy and prosperous New Year and to also thank you for being part of the *All Chevy Performance* family. Whether you've been along for the ride from day one, or if you've just recently discovered this magazine, we appreciate you being here and allowing us to keep the heartbeat of Chevy muscle car print media alive and firing on all eight cylinders. Without you, we wouldn't be able to do what we do: bring you the most informative technical articles designed to help keep your Chevy running hard, and to show the latest trend-setting Chevy muscle car builds in brilliant color photography.

With no plans of slowing down anytime soon, strap in, hold on, and get ready for another year of *All Chevy Performance*.

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I want to hear from you! Send an email to nlicata@inthegaragemedia.com.

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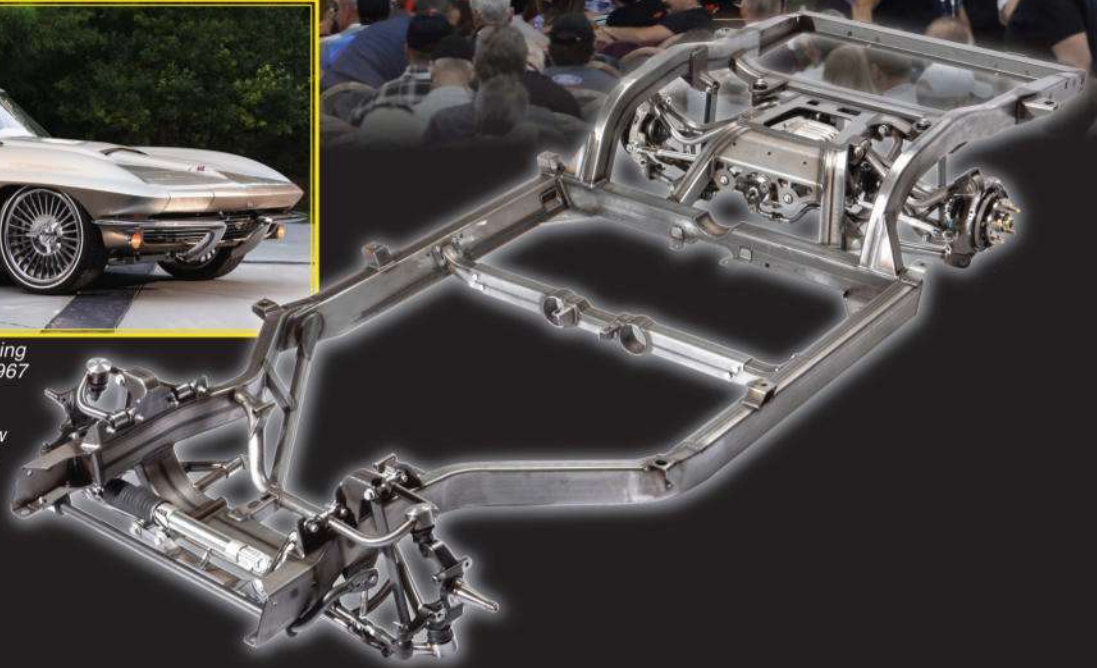

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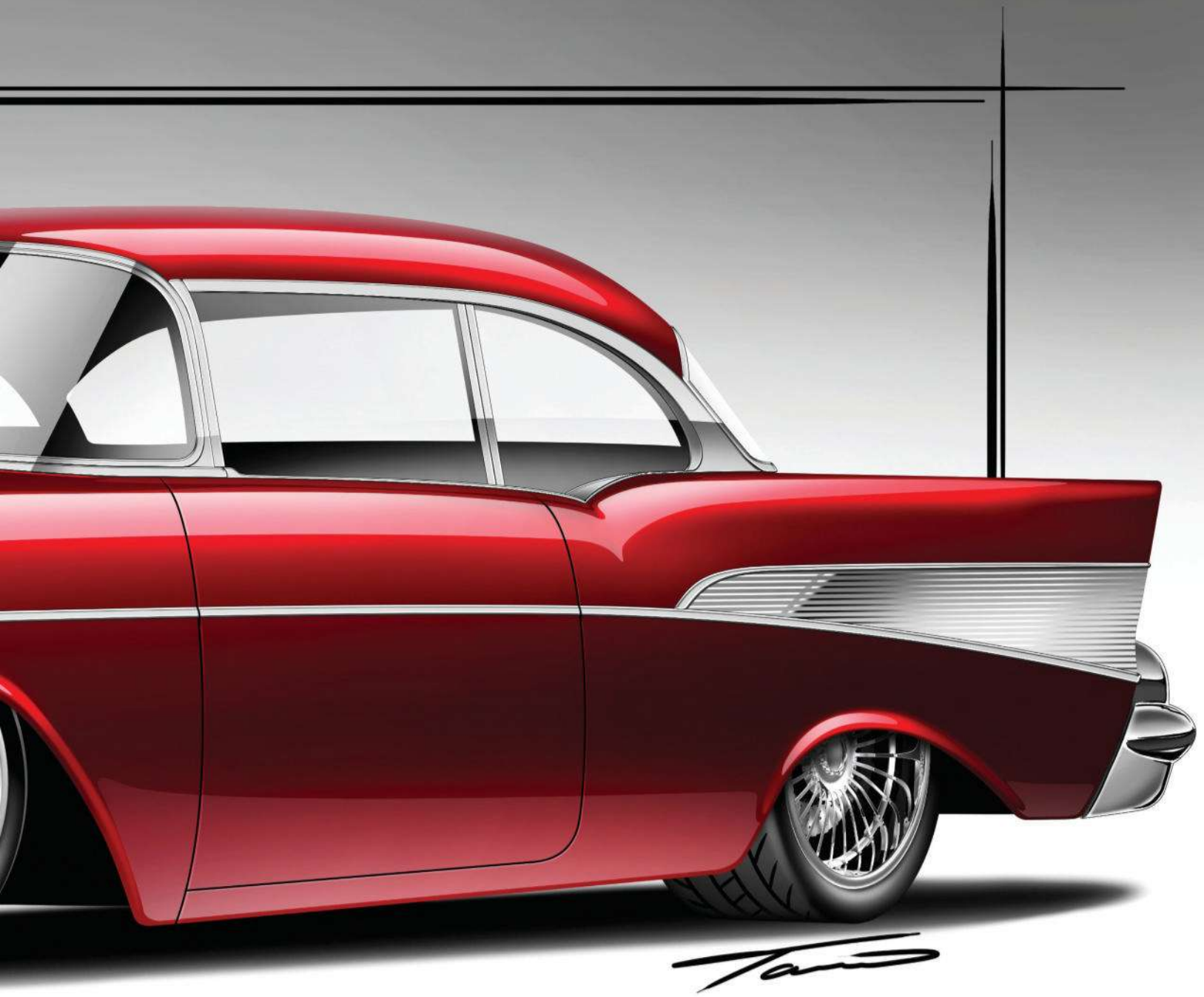
TEXT & RENDERING BY **TAVIS HIGHLANDER**

# 1957 CHEVROLET BEL AIR

The amount of detail and craftsmanship being poured into the fabrication of this project is truly next level. Starting on the exterior, the rear of the roof has been slightly pancaked to give it a thinner appearance. All the bumpers are modified so they can be tucked in tight to the body. On the hood you can see it has been shaved of the twin gunsights. Custom roof trim allows for a vent window delete and one-piece glass. Most of the trim is handmade or custom machined. Add a 2.5-inch body drop to that mix and you get a super custom 1957. ACP



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BY NICK LICATA IMAGES BY WES ALLISON

# ILLICIT

# JR & CELESTE VILLARREAL'S 1969 CAMARO

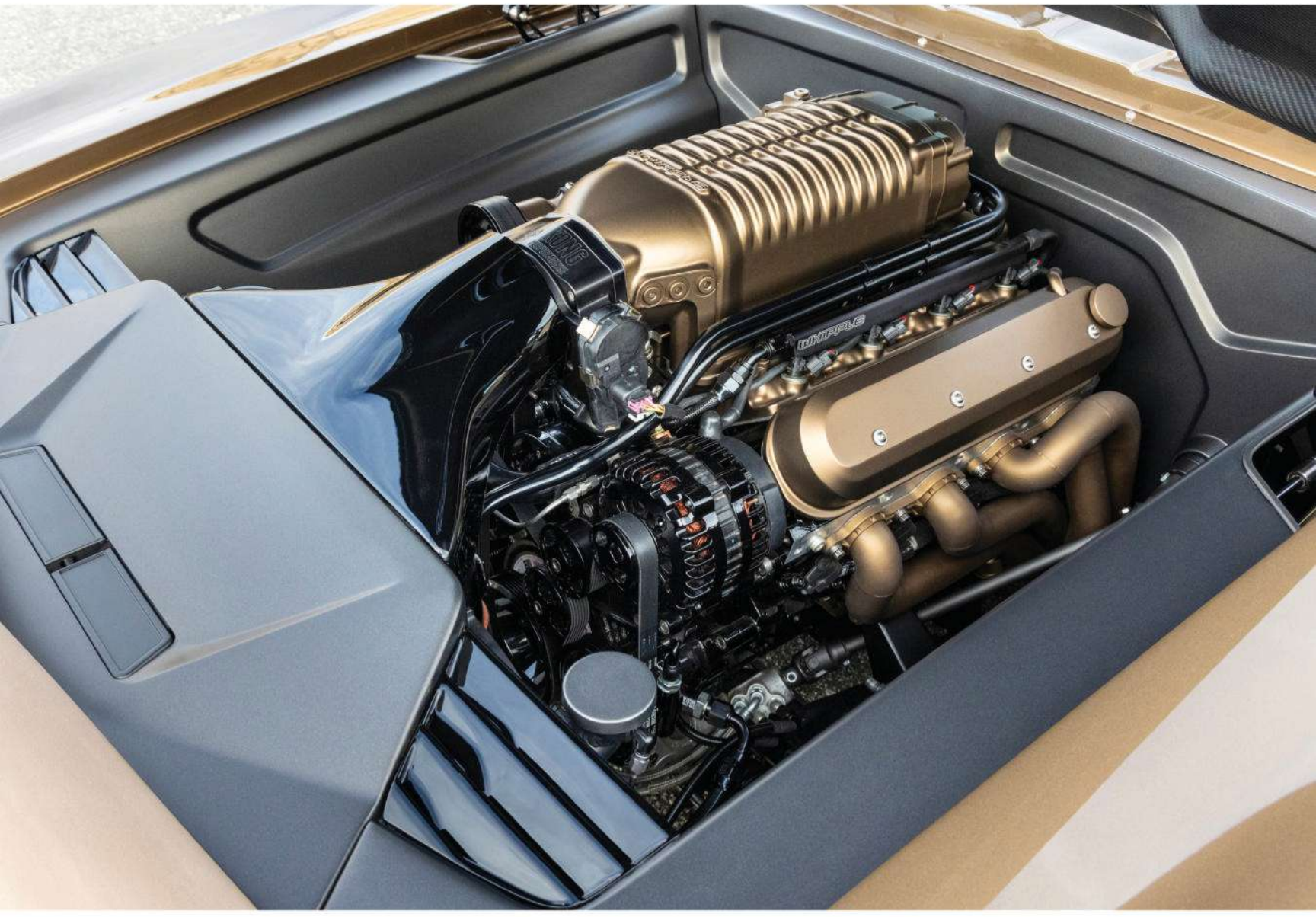
**"Illicit"** is defined as "something forbidden by law, rules, or customs." It also describes activities or behaviors that are illegal or disapproved on a social level. JR and Celeste Villarreal's incredible 1969 Camaro carries the moniker Illicit, but it's a car we approve of on every level.

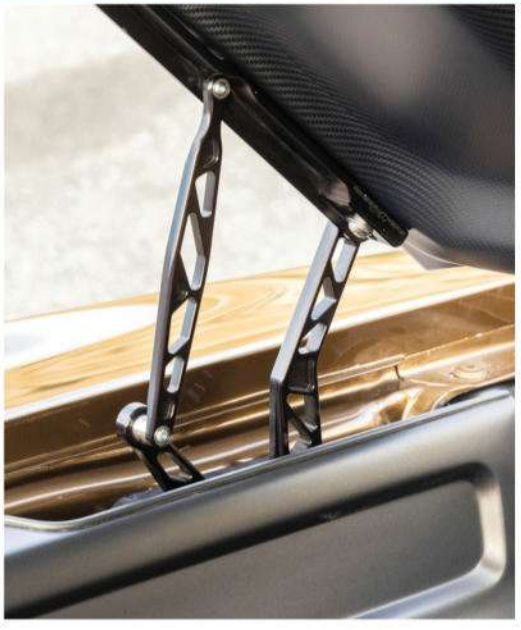
So how did this incredible Camaro come to be? Well, it started when JR was on the hunt for a first-gen Camaro. He was torn between buying a fully completed car or starting with a solid base to build from scratch. "I heard about a 1969 Camaro for sale in San Diego [California] that was listed in good condition, so he decided to drive down to check out. It appeared to be in decent shape," JR recalls. "The body was shiny, looked straight, and the 350 engine sounded strong. Unfortunately, it was all an illusion. After purchasing it I discovered it had major rust issues and had filler throughout the body. I was shocked that I just dropped $35K on a pile of rust."

JR learned about Jesus Lopez at Lopez Performance in San Bernardino, California, and was impressed with the quality of cars that had come out of his shop. He decided to take his ailing Camaro to Lopez and his crew to breathe new life into his vintage Camaro. Lopez Performance specializes in more than just restorations—they're known for building high-end, award-winning hot rods and muscle cars. JR was all in.

Lopez called in Sean Smith to help design a Camaro that would involve unique features to make JR's Camaro stand out from the plethora of all other 1969 F-bodies on the planet. Not an easy task, but this isn't Smith's first rodeo. His designs are known for transforming ordinary muscle cars into one-of-a-kind masterpieces, and in this case, still able to retain the 1969 Camaro's attractive factory vibe. JR approved of Smith's artistic approach, allowing Lopez and his crew to completely revamp the car inside and out.

Smith's design included accenting the Camaro's original features by incorporating custom carbon-fiber aerodynamic components, including splitters, rocker panels, a hood, and decklid. Before those elements became part of the build, Daniel Aguilar, lead fabricator at Lopez Performance, cut off the damaged panels and incorporated fresh metal to accommodate the numerous custom nuances. Lopez Performance's Miguel Barajas and Aaron Martinez took over from there and prepped the body to perfection prior to spraying the shell with a custom mix of Glasurit pigment aptly named Solar Flare Bronze.





Ensuring the car carried just the right stance and performance handling, a Speedtech ExtReme subframe rides up front and employes JRi double-adjustable coilover shocks paired with their torque arm rear suspension out back, also dampened by JRi shocks.

Baer six-piston calipers and 14-inch rotors are utilized on all four corners while a Wilwood $^{15}/_{16}$-inch master cylinder and Wilwood proportioning valve allow for excellent stopping power brought on by the Scott's Hotrods pedal assembly. Accenting the brilliant paintjob are set of Brixton Forged VL4 Carbon + wheels with black centers and carbon-fiber outers wrapped in street-gripping Michelin Pilot Sport rubber. It all helps elevate the F-body to the highest level of driveability combined with exceptional performance.

With all the aero upgrades, high-performance brakes, and suspension in place, JR knew a powerful engine was essential. After a brief discussion with Lopez, they decided on a Dart LSX 427ci engine. Prior to installation, Aguilar fabricated custom one-off panels for the engine bay creating a stunning showcase for the potent powerplant.

Thompson Motorsports in Nevada, Texas, handled the machining while Lopez Performance took on the assembly process. They topped it with a Whipple 2.9L supercharger and let the ensemble breathe through a set of Ultimate Headers headers, custom 3-inch exhaust, and JBA mufflers. The system produces an aggressive sound that matches the Camaro's visual personality.

A Bowler Performance–prepped TREMEC T-56 transmission, paired with a Tilton twin-disc clutch offers smooth gear shifts in a bulletproof package. A Currie 9-inch rearend stuffed with Eaton Truetrac posi, 3.73 gears, and 31-spline axles offer exceptional strength excellent power-to-the-ground performance.

The interior showcases a stunning blend of luxury and racing performance, designed by Sean Smith and brought to life by Lopez Performance and Gabe's Custom Interiors. Lopez crafted a custom dash with an aluminum insert, complemented by a set of Classic Instruments gauges. Gabe's followed through with Truffle Brown and black leather upholstery throughout the custom door panels, dash, center console, and floors. A pair of Recaro Sportster seats also received the custom leather treatment from Gabe's while a Schroth Racing harness is secured to the Detroit Speed rollcage. That stylish steering wheel is a custom creation by Lopez, mounted on an Ididit steering column.

Climate control was left in the hands of Restomod Air while the entertainment system installed by the gang at Art of Sound in Upland, California, offers a high-quality audio experience thanks to the Alpine head unit along with strategically placed JL Audio speakers throughout the cabin and a trunk-mounted sub.

"Growing up my mom talked about how much she loved her old Camaro, and I instantly envisioned a powerful 1969 Camaro. Years later, I realized the Camaro she once owned was a 1979 model, but by that point I was already deep in love with the first-gen Camaros, particularly the 1969," JR confesses. "With that said, I'm grateful for Lopez Performance coming to the rescue and doing a fantastic job of removing all the rust and giving us a foundation that is far superior to what these cars came off the assembly line with. Bringing in uber-talented car designer Sean Smith was an excellent decision. He was great to work with and helped make choosing a direction for the car extremely easy. His tasteful design elements totally make the Camaro stand out—way beyond my wildest dreams. I can't thank [Lopez] and his team at Lopez Performance enough for doing such an amazing job of taking a wild vision and turning it into reality." ACP

## TECH

**OWNER:** JR & Celeste Villarreal
**VEHICLE:** 1969 Chevy Camaro
**BUILD:** Lopez Performance, San Bernardino, California

### Engine
**TYPE:** Dart LSX
**DISPLACEMENT:** 427 ci
**MACHINEWORK:** Tompson Motorsports (Nevada, TX)
**ASSEMBLY:** Lopez Performance
**INDUCTION:** Whipple 2.9L supercharger
**EXHAUST:** Ultimate Headers, 3-inch custom exhaust, JBA mufflers
**VALVE COVERS:** Chevrolet Performance
**ACCESSORY DRIVE:** Wegner Performance
**TUNING:** Westech Performance
**ANCILLARIES:** Taylor wires, Aeromotive fuel system with in-tank TVS brushless pump, Rick's Tanks fuel tank, Ringbrothers hood hinges, SPAL fans
**OUTPUT:** 750 hp, 700 lb-ft of torque

### Drivetrain
**TRANSMISSION:** TREMEC T-56 by Bowler Transmissions
**CLUTCH:** Tilton twin-disc
**DRIVESHAFT:** ProMod carbon fiber by Aeromotive
**REAR AXLE:** Currie 9-inch, 3.73 gears, Truetrac posi, 31-spline axles

### Chassis
**FRONT SUSPENSION:** Speedtech Performance front subframe, JRi double-adjustable coilover shocks
**REAR SUSPENSION:** Speedtech Performance torque arm suspension, JRi double-adjustable coilover shocks
**STEERING:** Sweet Manufacturing rack-and-pinion
**BRAKES:** Baer 14-inch rotors, six-piston calipers front and rear
**MASTER CYLINDER:** Wilwood

### Wheels & Tires
**WHEELS:** Brixton Forged VL4 Carbon + 19x10 front, 20x12 rear
**TIRES:** Michelin Pilot Sport Cup 2 295/30R19 front, 345/30R20 rear

### Interior
**UPHOLSTERY:** Truffle Brown/black leather
**DOOR PANELS:** Custom by Gabe's Custom Interiors (San Bernardino, CA)
**CONSOLE:** Custom by Gabe's Custom Interiors
**DASH:** Custom by Lopez Performance and Gabe's Custom Interiors
**INSTALLATION:** Gabe's Custom Interiors
**SEATS:** Recaro Sportsters
**HARNESS:** Schroth Racing
**ROLLCAGE:** Detroit Speed, installed by Lopez Performance
**PEDALS:** Scott's Hotrods with Eddie Motorsports pads
**STEERING:** Ididit column, custom steering wheel by Lopez Performance
**SHIFTER:** Bowler Performance
**INSTRUMENTATION:** Classic Instruments
**WIRING:** American Autowire installed by Rene Davalos at Lopez Performance
**HVAC:** Restomod Air
**INSULATION:** Dynamat
**ENTERTAINMENT SYSTEM:** Alpine head unit, JL Audio speakers, JL Audio sub installed by Art of Sound (Upland CA)

### Exterior
**METAL FABRICATION:** Daniel Aguilar at Lopez Performance
**BODYWORK AND PAINT:** Glasurit Custom Solar Flare Bronze by Miguel Barajas and Aaron Martinez
**HOOD:** Custom carbon fiber
**GRILLE:** Custom by EVOD Industries
**FRONT BUMPER:** Custom carbon fiber
**REAR BUMPER:** Custom steel
**HEADLIGHTS:** Dapper Lighting
**TAILLIGHTS:** Custom
**SIDE MIRRORS:** Intek Otto
**GLASS:** Custom by Eddie Kotto

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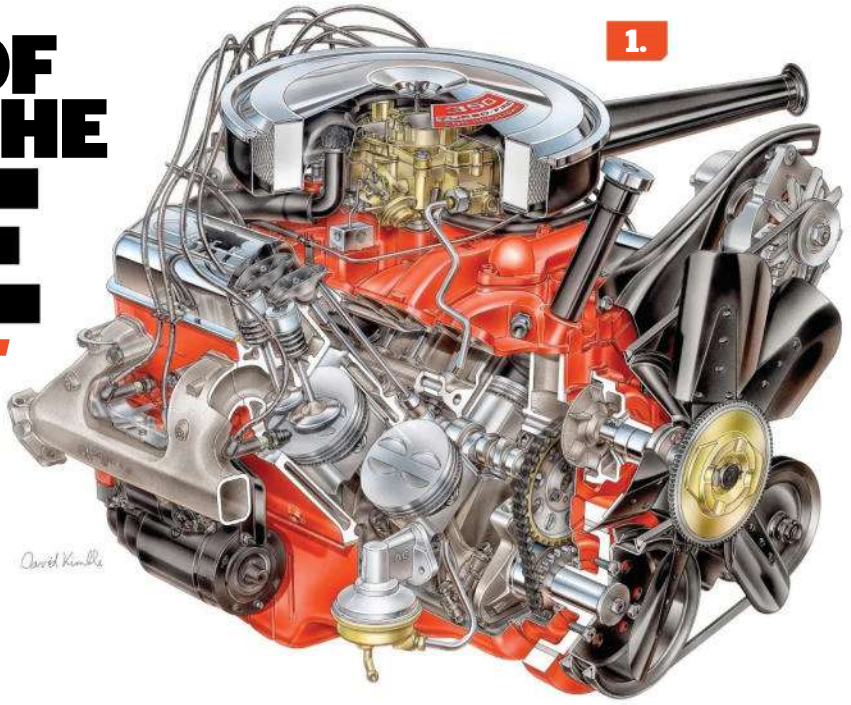
# THE TALE OF THE MOUSE

## HISTORY OF THE CHEVROLET SMALL-BLOCK ENGINE




BY **JEFF SMITH** ◣ IMAGES BY **VARIOUS SOURCES**

In the performance industry, there are very few products that can claim to have changed the lives of four generations of enthusiastic hot rodders. That's the impact that the small-block Chevy has had on the automotive performance game. The term "pervasive" does not even begin to explain it all. Along the way, the small-block Chevy has been the powerful backbone of racing sanctioning bodies and made many engine builders and racers more than famous. The small-block's impact on millions of street performance enthusiasts is immeasurable.

It all started in 1955 with the first year of the small-block Chevy bolted into both the Corvette as well as pedestrian 1955 Chevy sedans and coupes. Some say the small-block saved the Corvette, and likely this is true. The engine with the funny stamped rockers arms wasn't immediately embraced, but neither did it take long for the automotive industry to recognize its true potential.

The first small-block was a small displacement V-8 of only 265 ci, designed with supervision by engineering director Ed Cole and with a compact, crossflow cylinder head design by Don McPherson. The first iteration featured a two-barrel carburetor and was rated at a modest 162 hp. However, it didn't take long for those numbers to grow along with its displacement. By 1957 the little Chevy had expanded nearly 20 inches to 283 ci and would blossom to an aggressive 327 ci five years later in 1962. Eventually, of course, it would enlarge to its ubiquitous 350 ci in 1967. The largest of the production engine displacements hit its pinnacle in 1970 with the 400ci engine while still retaining the same bore spacing and deck height as the original 265.

At the time of its debut, the small-block was something of a radical departure from traditional engine design. Chevrolet would push the envelope further with a Rochester fuel injection system that debuted in 1957 sitting atop a 283 rated at an amazing 283 hp to become the first GM production engine to achieve 1 hp/ci. However, it was not the first domestic production engine to reach that achievement. That accolade goes to the 1956 FirePower V-8 hemi making 355 hp from 354 ci. That first generation hemi has now all but disappeared into obscurity while the little small-block Chevy was just getting started.

The 1970s would produce both the pinnacle of Gen I small-block horsepower and then just as quickly follow that with some of the worst horsepower ratings in its history. The 1970 LT1 would top the Gen I charts with 11:1 compression and 370 hp from 350 ci. That same year Chevy introduced its largest 400ci small-block with a huge 4.125-inch bore and stretched 3.75-inch stroke. This engine was never allowed to show is true potential and was mainly employed powering midsized pickups, the last of which appeared in 1980.

Emission laws soon squashed compression and that same powerful 350 found in Corvettes and Camaros in 1970 was by 1975 limping along with a pathetic L48 350 rated at a truly dismal 165 hp. But the future of the small-block would soon improve.

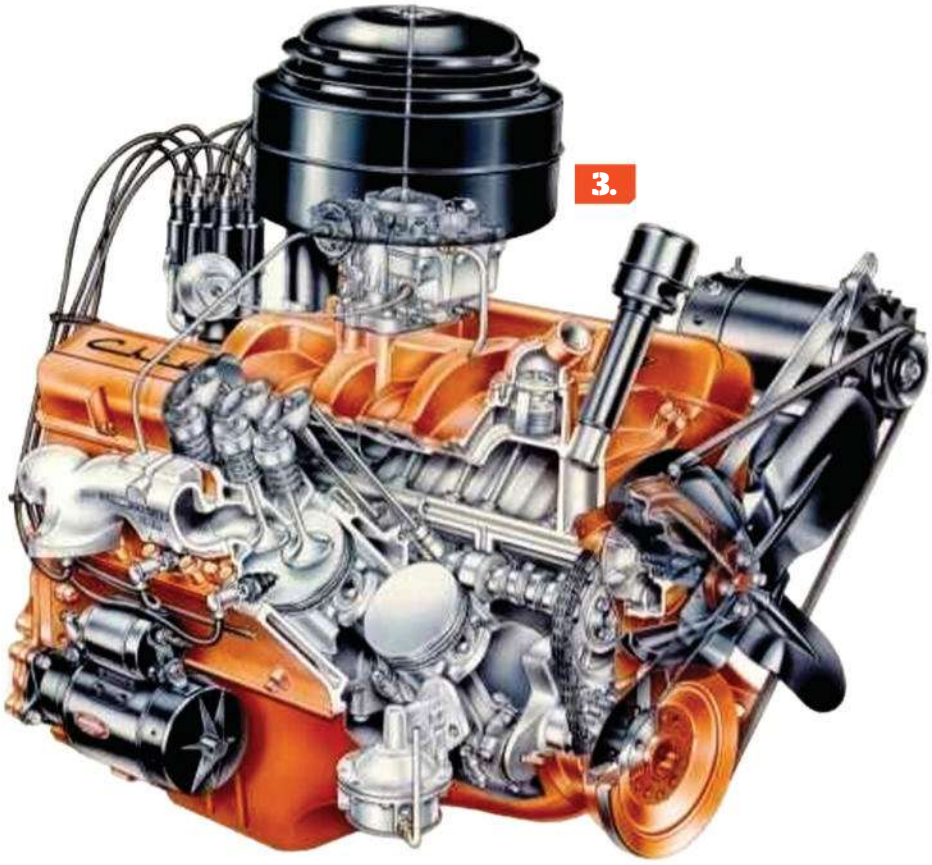
By the 1980s this little engine that could began multiplying with several smaller displacements as Chevy engineers experimented with mixing and matching bore and stroke. The famous 1967-1969 Z/28 302 was created to fit the 5.0L (305ci) displacement limit for SCCA Trans Am racing by mixing a 4-inch bore, 327 block with a 3-inch 283 stroke crankshaft. This was the first engine created by simply mixing existing parts. That idea spawned other variations of the small-block theme like the 307, which was the opposite approach created by combining the 283's smaller 3.875-inch bore with the 327's longer 3.25-inch stroke.

As emissions and fuel mileage and the dreaded Corporate Average Fuel Economy (CAFÉ) standards tightened, displacements shrank even more. The tiniest mouse motor evolved in 1976 as the 262ci with a 3.67-inch bore and a 3.10-inch stroke. Thankfully, it was short-lived.

These amendments in displacements occurred throughout the small-block's lifespan while it retained its original mid-1950s design configuration until the mid 1980s when Chevy finally recognized that the two-piece rear main seal was problematic. For 1986, Chevy introduced the first major change in the small-block's design with a one-piece rear main seal combined with hydraulic roller camshaft and lifters, which also demanded other minor alterations to the block with a stepped cam face and a cam limiter plate to prevent the camshaft from moving forward under high rpm.

Until this point, the production small-block had never varied from its cast-iron roots for both block and heads. Sure, Chevrolet engineering experimented with prototype aluminum heads and blocks as far back as the late 1950s, but these ventures were never pushed into production perhaps because the small-block was already relatively compact and light even when dressed in full cast iron.

**1-3. Among the millions of carbureted production small-block Chevys, the most impressive must be the 1970 LT1 350ci version. With 11:1 compression, big valve iron heads, a mechanical lifter cam, and a big Holley carburetor, this engine made a raucous 370 hp at 6,000 rpm in the Corvette and 360 hp in the Camaro.**




It's worth noting that the Bill "Grumpy" Jenkins' win at the inaugural NHRA Pro Stock drag race at the Winternationals in 1970 relied on ported iron castings for cylinder heads that were originally intended for pedestrian sedans. It would take until 1976 for that to change when Warren Brownfield poured the first aftermarket aluminum cylinder heads that eventually became what is now the current Air Flow Research (AFR) heads. Of course, now there are multiple sources, like Brodix, Edelbrock, Trick Flow Specialties (TFS), and many others, pouring aluminum alloy heads for the small-block.

It didn't take long for companies like Donovan and Rodek to build aluminum blocks for the small-block for racing, and while Corvette chief engineer Zora Arkus-Duntov had several aluminum block engines built for competition, including engines for the Grand Sport Corvettes in the mid 1960s, Chevrolet never saw the need to build an all-aluminum production block. The ZL1 all-aluminum big-block Chevy made more sense from a weight savings standpoint since the small-block would have only trimmed roughly 100 pounds from its iron version.

Returning to the small-block's production history, more evolutionary changes occurred in 1992 with the introduction of what is now called the second generation (Gen II) small-block. Dubbed the LT1, the engine first appeared in the Corvette that year with a completely new appearance.

The Gen II engine is easy to identify because the rear-mounted distributor was relocated to the front of the engine and driven off the camshaft. The ignition, referred to as the Opti-Spark, eliminated both the backlash between the camshaft and distributor gears but also offered more accurate ignition timing at higher engine speeds by eliminating the inherent problem of camshaft twist—especially when the engine was fitted with stiffer valvesprings.

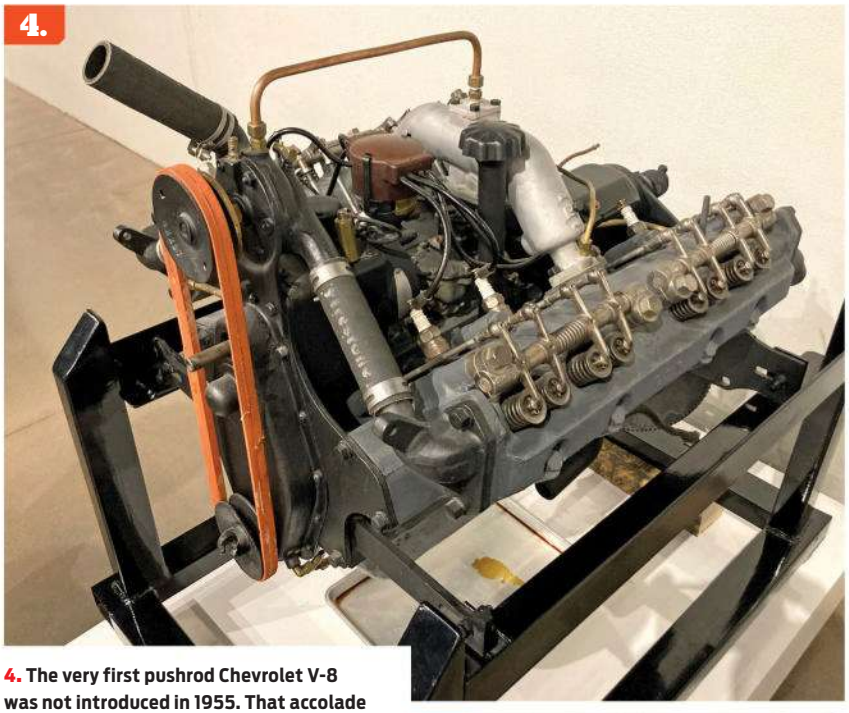
Another major change involved rerouting the cooling system. The LT1 introduced a reverse cooling system that pushed coolant first around the combustion chambers in the cylinder heads where the majority of the heat is generated. Then the coolant was directed downward through the block past the cylinders and returned to the radiator. The water pump was also driven off the front of the camshaft, which eliminated the cumbersome belt drive system.

The LT1 also used a very short runner intake manifold that was in many ways the opposite of its Tuned Port Injection (TPI) predecessor. The TPI featured very long intake runner tubes intended to improve torque while the LT1 offered a manifold with very short runners. The shorter runners offered intake tuning that enhanced peak horsepower but delivered this at the cost of low-speed torque.

The LT1 was quickly followed with the LT4 pushing the LT1's 300 hp up to 330 peak horsepower. These numbers might now seem a bit tame (especially when compared to today's 1,000hp production engines) but we must remember that back in the 1960s, Chevrolet and all the other manufacturers tested their engines using what is now called the standard or gross horsepower testing using an aggressive correction factor using 60 degrees F inlet air temperature, 0 percent humidity, and an atmospheric pressure standard of 29.234 inches of mercury (Hg). This rating system changed in 1971 to the J1349 standard of net horsepower ratings, which lowered the output with its more conservative correction factor. This further reduced the advertised horsepower numbers because part of the net power factor demands the engine run with all accessories, including its OE exhaust.

As mentioned, the Gen II small-block was short-lived and quickly dated by what became known as the Gen III or LS series of small-blocks. We won't dive into the details on this engine but, interestingly, Chevrolet engineers did Chevy enthusiasts a huge favor by maintaining five of the original six bellhousing bolt pattern locations, making it much easier for Bowtie enthusiasts to jump quickly into the Gen III/IV pool. Other items retained by the Gen III small-block include the original small-block's 4.400-inch bore spacing and the 0.842-inch lifter diameter.

But those minor details were where the new Gen III diverged with an all-new design. The biggest improvement was in valve angle where the old small-block was limited by its 23-degree angle, the LS pushed that over to a much more aggressive 15-degree angle and enhancing combustion efficiency with symmetrical intake and exhaust ports.




**4.** The very first pushrod Chevrolet V-8 was not introduced in 1955. That accolade belongs to the 288ci Series-D overhead valve V-8 produced in 1917 by Louie Chevrolet. The little V-8 featured a 3.36-inch bore and 4.00-inch stroke and generated 55 hp at 2,700 rpm from 4.75:1 compression. The engine used a centrally located camshaft and an exposed valvetrain that was common in early 20th century engines. Induction was handled by a single Zenith updraft two-barrel carburetor. This particular engine can be viewed at the Museum of American Speed in Lincoln, Nebraska, which should be a bucket list trip for any gearhead.

**5.** The 265ci small-block Chevy that debuted in 1955 was somewhat unique in that this original design did not employ a permanent oil filter mount. If you look closely at this engine on display at the Museum of American Speed, you will note no provision for an oil filter on the driver side rear of the block. There was an option for an add-on filter that employed a large canister placed on top of the engine with a small feed line and a return back to the engine. By 1956 all 265 and later engines were fitted with a canister oil filter in the traditional location. Spin-on oil filters began to appear in the mid 1960s.

**6.** When the 265ci small-block appeared in 1955, hot rodders were dubious of the spindly looking stamped steel rocker arms perched precariously on a $^{3}/_{8}$-inch free-standing stud. Engine builders were suspicious that the rocker would not take the abuse of sustained high engine speeds. At the time, most production valvetrains relied on massive steel rockers mounted on a heavy shaft. The small Chevy's innovative stamped steel rocker would prove more than capable of handling the stress of high rpm, at least until aluminum roller rocker arms were created.

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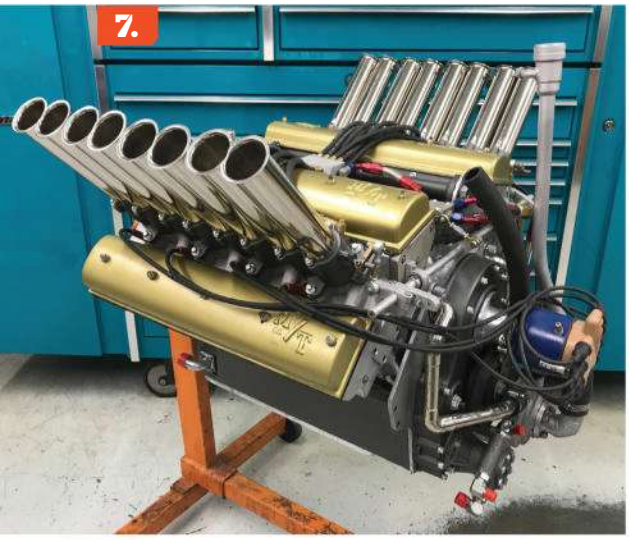
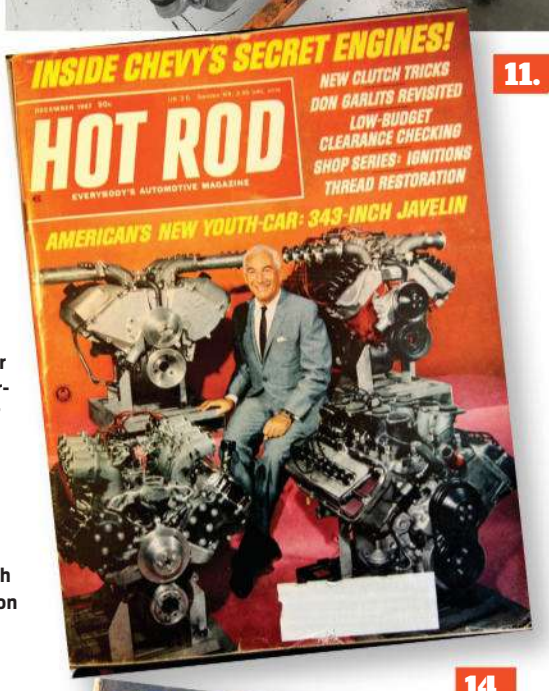



**7-9.** Legendary hot rodder Mickey Thompson wasn't afraid to try something different to power his way into the Indy 500 in 1967. This is his pushrod, three-valve stock-block Chevy with custom heads that appears to be a DOHC V-8 conversion but is in reality a pushrod-actuated, cam-in-block small-block. The exhaust valves are actuated by horizontal pushrods. The engine displaces 305 ci and reportedly made 565 hp in 1967, but unfortunately it did not fare well at Indy. The engine was restored by Bob Ore Restorations in Erie, Pennsylvania, and is owned by George Lyons. Photos courtesy of Greg Jones, *Engine Builder* magazine, Babcox Publishing.

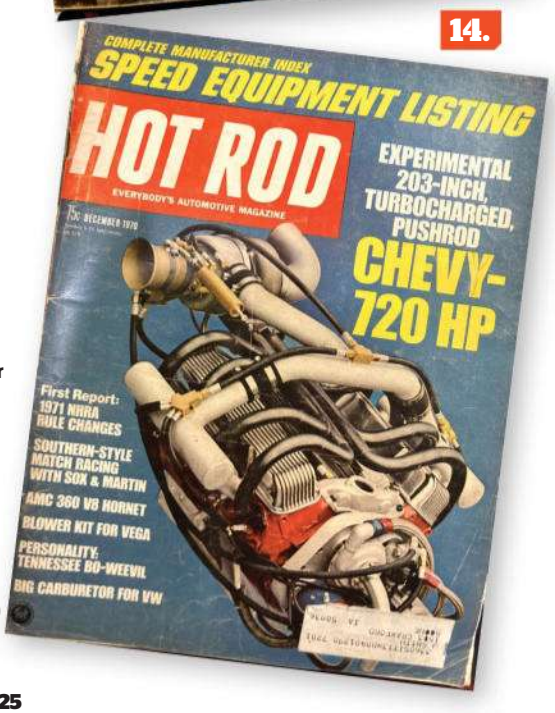
**10.** In 1964 and 1965 you could get a 375hp, Rochester fuel-injected 327 that was the halo engine for the Corvette before the big-block appeared in 1965. This 327 achieved peak power at 6,200 rpm. The second year, 1965, was also the last for mechanical fuel injection.



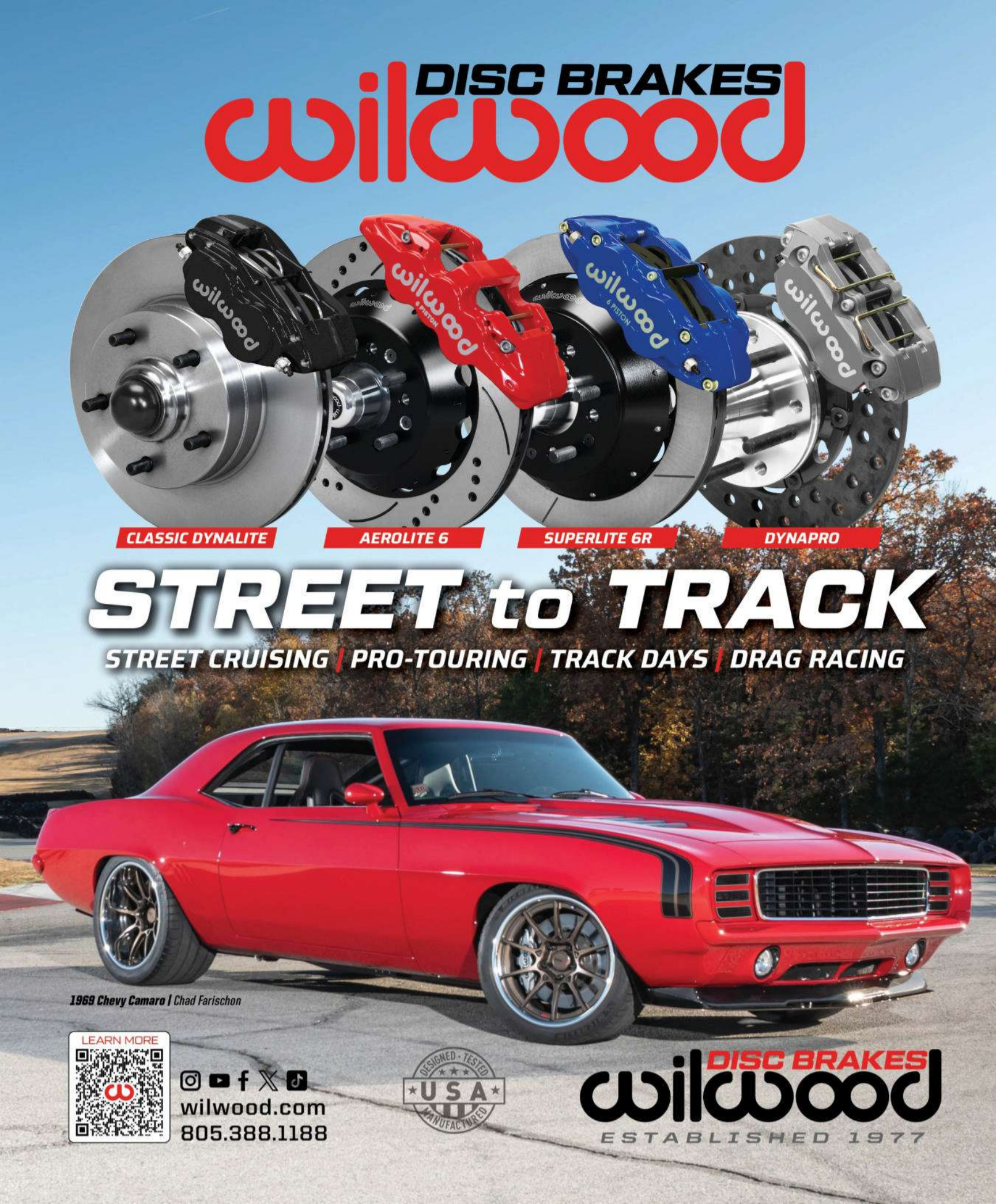

**11.** The mid 1960s were a time of great change, both socially and with automotive engineering. In 1967, *Hot Rod* magazine featured this tantalizing cover with Chevrolet's Zora Arkus-Duntov posing with a collection of exotic small-block Chevy engines, none of which ever made it into production.

**12.** Chevrolet recognized the value of Trans Am racing a bit late and had to create a 5.0L (305ci) engine for the then-new 1967 Camaro by combining a 4-inch bore 327 block with a 283's 3.00-inch stroke. Thus was born the now-legendary 302ci Z/28 engine. This particular Traco-built engine is fitted with a cross-ram intake that appeared in competition in 1968.

**13.** Modern small-block Chevy engine builders are blessed with the choice of dozens of aftermarket aluminum heads in various port sizes and configurations. But 50-odd years ago, it was Bill Jenkins who won the inaugural NHRA Pro Stock drag race in 1970 using a pair of hand-ported production iron castings. The Mouse motor has come a long way since then.




**14.** Also, in 1970 Bruce Crower built a radical 203ci turbocharged small-block for the Indy 500. The displacement was undersized to fit within USAC rules with a 3.75-inch bore and 2.30-inch stroke. The engine was notable for moving the intake ports to the exhaust side of the heads to improve flow. Dyno testing revealed an impressive 720 hp at 22 psi. That calc's out to an astonishing 3.5 hp/ci.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**15.** Can Am racing in the late 1960s is remembered as being powered by monster all-aluminum big-block Chevys with calliope intakes. But early Can Am cars like this beautiful Lola T70 owned by hot rodder David Pozzi were powered by carbureted small-block Chevys.

**16.** Chevrolet attempted to enhance Corvette's image in 1994 with a dual overhead cam (DOHC) engine designed by Lotus of England and assembled in the U.S. by Mercury Marine. The RPO LT5 described a 5.7L engine with 405 hp in its final version in 1995. This was impressive given that two-valve, pushrod Corvette engines at the time were making no more than 300 net horsepower. But even with this additional power, the complexity and size of the DOHC engine never caught on with enthusiasts. By 1998, the flag would be passed to the then-new LS1 Gen III engine.

**17.** The latest production small-block is a Gen V offshoot of the original small-block. The engine in the photo is the 6.2L LT2 rated at 490 hp and 470 lb-ft of torque. It's a dry-sump lubricated, direct-injected engine with 11.5:1 compression. This is the base engine package for the C8 Corvette that also offers variable valve timing and Active Fuel management (AFM) that helps to deliver 24 mpg highway fuel numbers. That's impressive efficiency from a large, 376ci engine.

## SMALL-BLOCK DISPLACEMENTS

| DISPL. | YEAR | BORE | STROKE | MAIN JRNL. | MAIN BOLTS |
|---|---|---|---|---|---|
| 262 | 1975-1976 | 3.671 | 3.10 | 2.45 | 2-bolt |
| 265 | 1955 | 3.75 | 3.00 | 2.30 | 2-bolt |
| 265 | 1994 | 3.736 | 3.00 | 2.45 | 2-bolt |
| 267 | 1979-1981 | 3.50 | 3.48 | 2.45 | 2-bolt |
| 283 | 1957-1967 | 3.875 | 3.00 | 2.30 | 2-bolt |
| 302 | 1967-1968 | 4.00 | 3.00 | 2.30 | 2-bolt |
| 302 | 1969 | 4.00 | 3.00 | 2.45 | 4-bolt |
| 305 | 1986-1997 | 3.736 | 3.48 | 2.45 | 2-bolt |
| 307 | 1968-1973 | 3.875 | 3.25 | 2.45 | 2-bolt |
| 327 | 1962-1967 | 4.00 | 3.25 | 2.30 | 2-bolt |
| 350 | 1967-1997 | 4.00 | 3.48 | 2.45 | 2-/4-bolt |
| 400 | 1970-1980 | 4.125 | 3.75 | 2.65 | 2-/4-bolt |

Just for fun, we theoretically created a small-block fusion of sorts by combining the smallest production bore (3.50 inches) block with the shortest OE stroke crank (3.00 inches), which equal 231 ci—not that anyone would want to do that.

## TOP 10 STRONGEST PRODUCTION SMALL-BLOCKS

With regard to factory horsepower ratings, keep in mind that all the engines in this list are rated using the traditional SAE J1995 gross horsepower rating system. This correction factory uses healthy standards for air temp and pressure and combined with the fact that the engines were not fitted with an accessory drive or mufflers. A pure stock 1964 375hp fuelie 327 today would be challenged to achieve its rated horsepower if it were fitted with stock iron exhaust manifolds and driving a water pump.

**375hp** 327 1964, L84 Rochester Fuel Injection
**370hp** 350 1970, LT1, Holley 4bbl.
**365hp** 327 1964, L76, Holley 4bbl. (first Holley four-barrel used on a small-block)
**360hp** 327 1962, Rochester fuel Injection
**350hp** 327 1965-1967, Holley 4 bbl.
**340hp** 327 1962, Carter AFB
**325hp** 327 1967, Holley 4bbl.
**300hp** 327 1964, L-76, Carter AFB
**295hp** 350 1967, L-48, Quadrajet
**290hp** 302 1967, Z/28, Holley

So, does the ascendency of the Gen III/IV/V dictate that the original small-block Chevy is dead? That could not be further from the truth. The reality is that while the LS officially replaced it in 1998, the original "Mouse motor" continues to make its presence known as the once and still king of not only race sanctioning bodies but street enthusiasts all over the world. It's safe to say that the small-block will still be setting records at Bonneville, NHRA competition, and certainly making its mark on the street for decades to come. ACP

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## Steering You Forward

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## BILL SHEPHERD'S 1957 CHEVY BEL AIR GASSER

BY **FUELISH MEDIA** ◥ IMAGES BY **THE AUTHOR**

When it comes to the timeless, muscle-minded aesthetic that is known as "gasser" style, there are quite a few "OGs" still building them properly to this day. Bill Shepherd of Ridgeley, West Virginia, is one of those guys who has been into custom cars for just over 60 years now, and he still can't seem to get enough of them. Bill has been part of multiple car clubs in his time and is never not looking for cars in desperate need of an overhaul. As a member of The Clockers Car Club in Cumberland, Maryland, from 1957-1972, and now a proud member of The Right Coast Gassers, Bill has remained active in the scene he loves for decades with no signs of slowing down.

"In the past 10 years, gassers have become popular in our area," Bill says. "I found this 1957 Bel Air sitting behind an Advance Auto Parts store in Kingwood, West Virginia. The owner was a teenager who bit off more than he could handle, as the car needed a lot of work. I offered him $7,000 for it, which was probably too much, but he was happy with it and so was I."

Now, Bill had his work cut out for him as the Bel Air immediately needed new floorpans, body mounts, and the engine needed to be rebuilt. Luckily for Bill, his son Richard owns and operates Shepherd Speed Shop, so the car found its way to the right place while also having help from friend Jim Frost of Frosty's Speed Shop. To reach the trademark nose-high stance that is emblematic of the gasser class, a 1938 Chevy I-beam axle with drilled-out holes to save on weight was bolted onto the Bel Air along with a set of leaf springs. Then, for extra traction under load, custom ladder bars were made and attached.

GM disc brakes up front, and rear drums were then added, along with a 1978 Pontiac Firebird master cylinder and factory GM pedal assembly to build upon the refreshed chassis system. "I got really lucky when it came to finding wheels for this car," Bill admits. "While out at an auto flea market, I found a complete set of real-deal 1960s Cragar wheels in excellent shape. And for tires, I went with rear 7-inch slicks."

Instead of trying to salvage the 350 engine, he figured it best to reach out to Rhodes Performance Machine in Somerset, Pennsylvania, for a refreshed 1968 454ci mill that was bored to 460 ci. From there, the engine was assembled with help from Mike "Coin" Leasure and received a healthy dose of performance goods from the likes of Speed Pros TRW forged pistons, Lunati Voodoo camshaft, and Hedman headers, among many other additions, but it's the Weiand Tunnel Ram intake manifold and the velocity stack air cleaners that make the strongest first impression. Oh, and let's not forget the tall Mickey Thompson valve covers are damn cool as well.

After a bit of bodywork by Triple S Auto Care, Bill lined up his car to be freshly repainted in the same Matador Red color. Aside from treating some of the factory parts to a refreshing chrome bath courtesy of East Tennessee Chrome Plating, the car was purposely kept largely original with a few minor mods, like cutting holes in the rear bumper and even the hood to accommodate the Weiand intake. But the addition that hits close to Bill's heart is the Mickey Thompson water-transfer decal on the window as he mailed it in a love letter to his girlfriend who later became his wife. Bill included it for her to save back in 1966 while he was serving in the army. Over time he forgot about it but recently discovered it in his attic and knew there was a place for it on the window of this car.

Having solidified the exterior, Bill enlisted the assistance of Hot Rod Upholstery in Altoona, Pennsylvania, to upholster the factory bench seat, door panels, and headliner in white vinyl. The rear seating row was removed to lighten the Bel Air's footstep, so if you're looking to hitch a ride with Bill, be sure to plan accordingly. Next, the factory dash insert was polished up nicely, as were the factory pedals that were also drilled out in the same fashion found elsewhere on the car to shave even more weight. "Hey, every little bit helps," Bill laughingly says.

While Bill was easily sold on the factory roof option and color of the Bel Air, he did have another reason for buying the car off that kid years ago. "The fact that I owned two 1957 Chevy cars in the '60s helped make my decision," he adds. "It's great to be driving another one." And rest assured, that Bill along with his friends in the Right Coast Gassers drive their cars to every event they attend. This is a top priority within the club, and Bill insisted on making that point clear as crystal. "Nothing beats cruising while surrounded by six other gasser cars. We drive our vehicles around here. They are never trailered." ACP

## TECH

**OWNER:** Bill Shepherd, Ridgeley, West Virginia
**VEHICLE:** 1957 Chevy Bel Air

### Engine

**TYPE:** 1968 Chevy 454
**DISPLACEMENT:** Bored to 460 ci by Rhodes Performance Machine (Somerset, PA)
**CYLINDER HEADS:** Air Flow Research aluminum heads
**CAMSHAFT:** Lunati Voodoo
**INDUCTION:** Weiand Tunnel Ram intake manifold
**IGNITION:** MSD Pro-Billet distributor, Accel 8mm wires
**ASSEMBLY:** Mike "Coin" Leasure
**COOLING:** Edelbrock water pump, Champion aluminum radiator
**EXHAUST:** Hedman headers with block-off caps, 3-inch exhaust system with Flowmaster Flow FX mufflers
**DRESS UP:** Velocity stacks with Fram filters
**FUEL TANK:** Factory 16-gallon steel GM tank, Holley high-volume fuel pump

### Drivetrain

**TRANSMISSION:** TREMEC Magnum six-speed assembled by Hanlon Motorsport
**CLUTCH:** Ram HD Powergrip with billet flywheel
**DRIVESHAFT:** Shortened original, 1350 U-joints
**REAR AXLE:** 1958 Oldsmobile 9.3 housing with Fabcraft 4.56 gears and limited-slip differential

### Chassis

**CHASSIS:** Stock GM steel frame
**FRONT SUSPENSION:** 1938 Chevy I-beam axle with holes drilled, early Chevy spindles, leaf springs, reconditioned factory steering box with steering damper from SO-CAL Speed Shop, Monroe-Matic Plus shocks
**REAR SUSPENSION:** Leaf springs, Custom ladder bars, Monroe-Matic Plus shocks
**BRAKES:** GM 11-inch brakes (front), GM drums (rear)

### Wheels & Tires

**WHEELS:** 15x6 and 15x8 1960s Cragar
**TIRES:** 6.70-15 Coker bias-ply (front), 8.20-15 Radir 7-inch slicks (rear)

### Interior

**UPHOLSTERY:** White vinyl by Hot Rod Upholstery (Altoona, PA)
**SEATS:** Factory GM bench seat
**SEATBELTS:** Aftermarket
**STEERING:** Factory GM column, Grant three-spoke steering wheel
**INSTRUMENTATION:** Stewart-Warner Green Line gauges
**PEDALS:** Factory pedals with holes drilled by owner
**SHIFTER:** Hurst
**SAFETY:** Lakewood three-point rollbar

### Exterior

**BODYWORK & PAINT:** Bodywork by Triple S Auto Care (Paw Paw, WV), Matador Red (factory color) by Dave Barnes (buffed by Barry Levin of Jenkins Automotive (Clarysville, MD)
**HOOD:** Factory GM steel
**GRILLE:** Factory with 2-gallon Moon tank (for race gas) placed in front of grille
**BUMPER:** Factory rear bumper with aluminum inserts

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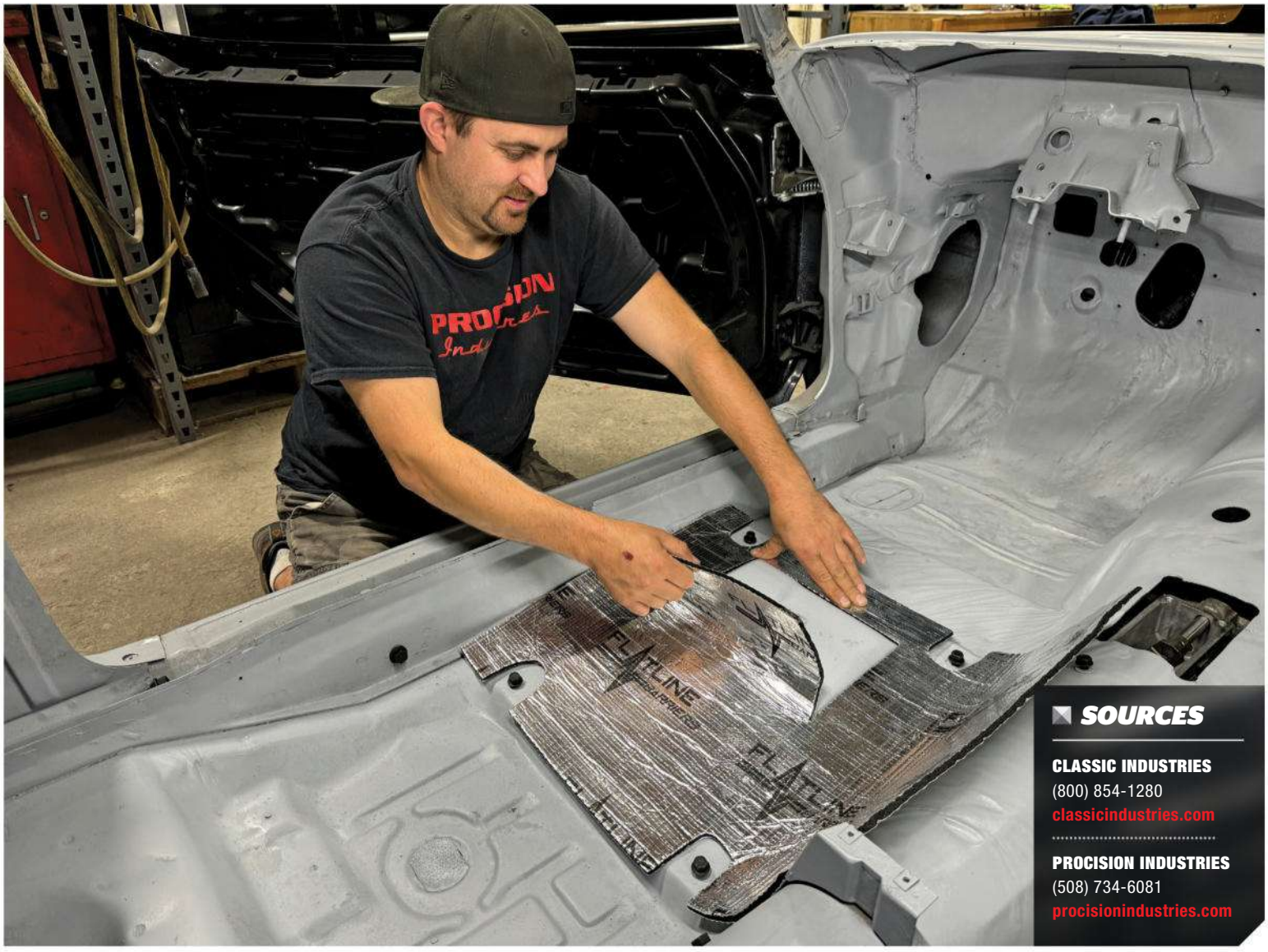


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# RATTLE NO MORE

## INCREASING SECOND-GEN CAMARO CABIN COMFORT

BY **CHUCK VRANAS** IMAGES BY **THE AUTHOR**

There's nothing worse than hitting the road in your high-performance Chevy and being assaulted by excess heat and vibration as you lay down the miles. Between adding an upgraded driveline and high-flow exhaust, the amount of heat generated has a direct connection through the floorpan. This moves straight into your interior and there's no way the factory jute-style padding will suffice to handle the job. Regardless of whether you're taking on a full build or simply making updates, it's a solid idea to think about upgrading your insulation complemented by sound deadening to help tame all that rattle 'n' roll generated by the road. We're here to tell you that there's a simple solution to the problem, one that you won't even break a sweat over, when installing products direct from the makers of Flatline Barriers.

**1.** To add the perfect combination of insulation and sound deadening to the second-gen Camaro, we contacted Classic Industries for three Flatline Barriers Direct-Fit kits to work with our application, including ones for the entire floor, roof, and doors.

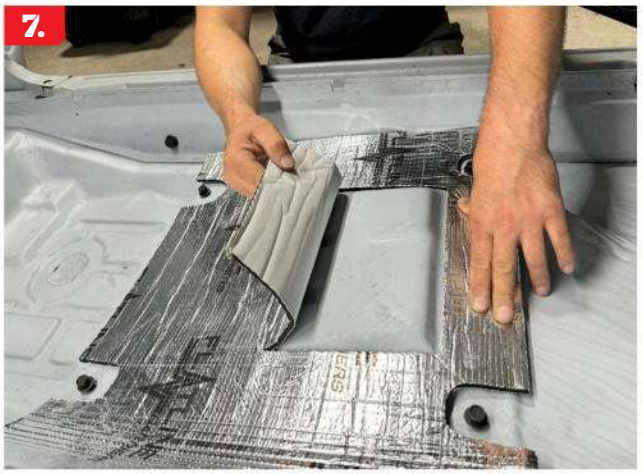
**2.** Here, you can see the complete empty interior as this is an ongoing full build, which has been stripped to bare metal and sealed with epoxy primer.

**3.** To begin, Pat O'Brien of Procision Industries prepares to clean the area, starting with completely vacuuming it of any visible debris.

**4.** Next, the manufacturer recommends cleaning the application surface with a degreasing agent. For this job, O'Brien used UPOL System 20 Fast Drying Degreaser (PNUP2012). Making sure to cover the entire application surface, spray one section at a time and wipe down with clean microfiber-style cloths. Then allow ample time to completely dry before proceeding to the next step.

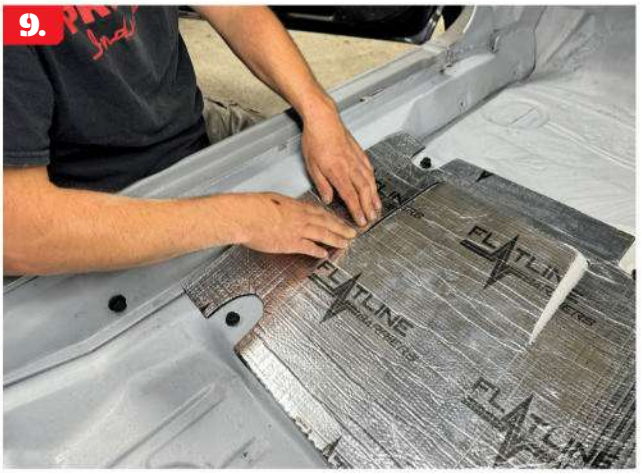
**5.** The direct-fit floor kit (PN TABF2012) comes complete with nine precut sections, as shown, ready for installation with the only tool needed being a razor blade and/or scissors for minor trimming, if needed.

**6.** Be sure to have all bolts in place for fitment in cutting access areas prior to installing the insulation sections. Here you can see the mounting bolts for the center console installed as a guide. Remember, any wiring you wish to have access to after the installation will need to remain above the insulation.




**7.** Test-fit every section prior to the installation. Here, the driver side floor seat section is precut to allow for the seat mounting bolts as well as raised area of the floorpan.

**8.** O'Brien then peeled back half of the adhesive barrier backing to begin the installation, Note, you should be sure of perfect alignment prior to placement as the self-adhesive barrier is extremely sticky and unforgiving to movement once set in place.




**9.** With half of the section set in place, it's as simple as applying hand pressure to the outer surface to secure it to the surface of the floor while following all the curves in the area.

**10.** Follow by removing the balance of the adhesive barrier backing to prepare it for installation.

**11.** Press into place and move across the section, moving toward the center of the floorpan.

Regular readers of *All Chevy Performance* will recognize the 1971 Camaro showcased across our pages, having followed its transformation from that of a bare shell. Over time, we focused on its suspension, brakes, LS driveline, cooling, exhaust, sheetmetal, and wiring. As we head deep into the interior, our initial thought was to give it a more civilized experience by trying to eliminate excess heat and road noise, especially with it packing an aggressive LS underhood. Recently, we followed up at Procision Industries in Taunton, Massachusetts, where shop owner Pat O'Brien was preparing to move forward by taking on this very subject. After reviewing various offerings on the market, he made a decision to contact Classic Industries, one of the distributors for Flatline Barriers.

If your company slogan is "Where heat and sound meet their maker," you'd better be able to live up to it. We're here to tell you that the product, comprised of an external aluminum thermal barrier, eliminates radiant heat while its second layer of ultra-lightweight foam silences unwanted noise, vibration, and resonance with a totally light-as-a-feather formula. With its simple peel 'n' stick application requiring no special tools except for hand pressure and a razor (or scissors) to occasionally trim, it's a snap to install, especially for a DIY afternoon project once the area is prepped. It's also important to note that the product is extremely flexible and able to be installed in any ambient temperature.

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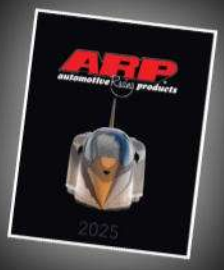


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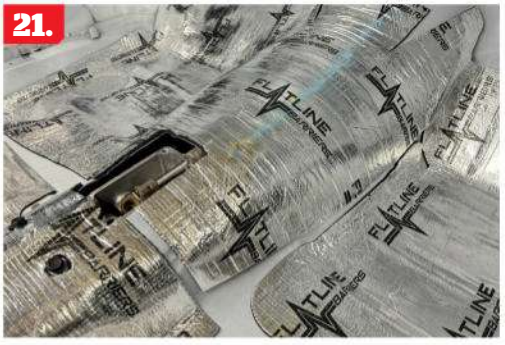

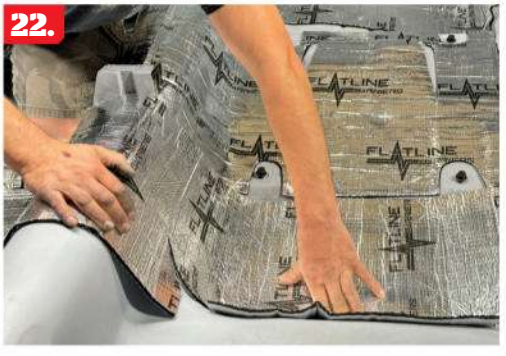


**12.** As the section was approaching the transmission tunnel, a simple cut was made to accommodate the bolt for the center console using a razor blade.

**13.** One simple cut made for a perfect fit.

**14.** The completed section was a snap to install; note how perfectly it conforms to the floorpan.

**15.** The front driver and passenger floor seat sections are now set in place.

**16.** The driver side footwell section was then test-fitted as the next step of the installation.

**17.** Once fitment was confirmed, half of the adhesive barrier backing was removed to get started. Continue to complete while pressing the panel into place.

**18.** Here you can see the completed installation to the front half of the interior floorpan.

**19.** The transmission section was then test-fitted into place.

**20.** Since there are many variations for transmissions, depending on whether your car is stock or modified, the section is left blank, allowing the user to customize it to fit their needs. This area was completed with a razor blade once confirmed.

**21.** Nice, clean fitment to the tunnel is complete.

**22.** The rear passenger footwell area comes in one large section. Be sure to test fitment before getting started.

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**23.** For ease of installation, O'Brien chose to remove small sections of the adhesive barrier backing and start the placement from the transmission tunnel, working his way outward on each side into the footwells.

**24.** The largest single section for installation was for the rear seat area of the floorpan. Once again, test-fit to ensure fitment and gradually remove adhesive barrier backing and press into place, conforming to all areas.

**25.** Next, the smallest filler panel sections were set into place.

**26.** Here, you can see the incredible amount of coverage provided by the kit, covering every area of the floorpan with Flatline Barriers insulation and sound-deadening material.

**27.** Placement of the roof insulation and sound-deadening kit (PN TABF2031), once the surface area was prepped, was simple, taking only a few minutes to install.

**28.** Our final step was prepping the doors for the sound deadening and insulation kit (PN TABF2004). Here you can see the inner sections once they were set in place.

**29.** Finally, a test-fit was done on the inner door section; once confirmed, the adhesive barrier backing was peeled, and they were set in place. Note there are several pre-punched areas that can be opened up for inner door access, if needed.

**30.** The finished installation is simply amazing with not only its complete interior coverage but also the time saved during the installation process. The second-gen will now benefit from excellent sound deadening once it hits the road, and to us that's well worth the investment.

Flatline Barriers has engineered complete precut kits for an exact fit in an endless array of muscle cars and trucks while also offering universal kits for custom applications. For our installation, we selected three individual precut kits to cover the floor, roof, and door areas with part numbers TABF2012, TABF2031, and TABF2004, respectively. By raising the bar, they have incorporated cutting-edge technology and materials to create a true lightweight solution in significantly reducing unwanted heat and sound from your interior. Follow along as we show just how simple and effective an afternoon install can be.

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**MID-AMERICA STREET ROD NATIONALS**
MAY 23RD – 25TH, 2025
**OZARK EMPIRE FAIRGROUNDS**
SPRINGFIELD, MISSOURI

**STREET ROD NATIONALS EAST**
JUNE 6TH – 8TH, 2025
**YORK EXPO CENTER**
YORK, PENNSYLVANIA

**MOBILE BAY STREET ROD NATIONALS**
JUNE 20TH & 21ST, 2025
**THE GROUNDS**
MOBILE, ALABAMA

**ROCKY MOUNTAIN STREET ROD NATIONALS**
JUNE 27TH & 29TH, 2025
**COLORADO STATE FAIRGROUNDS**
PUEBLO, COLORADO

**56TH STREET ROD NATIONALS**
JULY 31ST – AUGUST 3RD, 2025
**KENTUCKY EXPOSITION CENTER**
LOUISVILLE, KENTUCKY

**QUAD CITIES STREET ROD NATIONALS**
AUGUST 15TH & 16TH, 2025
**MISSISSIPPI VALLEY FAIR**
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**NORTHEAST STREET ROD NATIONALS**
SEPTEMBER 12TH & 13TH, 2025
**CHAMPLAIN VALLEY EXPOSITION**
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**KALAMAZOO COUNTY EXPO CENTER**
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**NSRA EVENTS**

# Sweet Ultra Street

## JOHN WOODS' 1970 CHEVELLE

BY **NICK LICATA** ◥ IMAGES BY **NOTSTOCK PHOTOGRAPHY**

Hot rodders can be a fickle bunch. We build a car with plenty of horsepower, drive them for a while, then crave more power—a never-ending pursuit for most. Such is the case with lifelong hot rodder John Woods and his 1970 Chevelle. "I bought the car in 2000, and being it was from Arizona the sheetmetal was in good condition," John explains. "It had a warmed-over 468ci engine, which I swapped in a 540 roller engine built by Bob Snyder. I drove it in that configuration for about 10 years. In 2013, I upgraded the suspension, did some interior work, and swapped in another engine, this time a Lingenfelter 548 big-block, because, of course, I was always chasing horsepower."

In the summer of 2018, the engine suffered a needle bearing failure. Around this time, John became interested in the Drag Week movement and started noticing more Ultra Street class–style cars cruising around Detroit not far from his home in Rochester. Tom Baily's well-known 1969 Camaro was a major influence on the direction John wanted to take his Chevelle.

"As I continued to ponder my engine options, I wanted something completely badass and, of course, with a power adder," John explains. "I also wanted a more modern wheel and tire combination, and to lower the car more than the 2 inches it already was." John called Steve Morris and ordered one of his 540 Stage II engines complete with a Procharger blower.

At first, the idea of another engine swap seemed simple, but John soon realized the stock chassis wouldn't be able to handle the 1,500-plus horsepower engine. Seeking advice, he reached out to Bryant Goldstone, who also had a 1970 Chevelle equipped to manage big power. Goldstone suggested some major chassis modifications, which was out of John's expertise and skill level. That led John to Rocky Troxell at U.S. 12 Speed and Custom in Michigan to discuss his vision for the Chevelle—a Drag Week car without the 3,500hp engine, but lean into something around 1,500 hp instead. Troxell, a second-generation fabricator and chassis builder recommended replacing the stock chassis with a Roadster Shop SPEC chassis. John was all in.

To make it work, Troxell's team performed some slight modifications to the Roadster Shop chassis to fit the U.S. 12 Speed long tunnel suspension system. Further modifications included widening, then raising the transmission tunnel to accommodate the beefed-up 4L80E transmission, while at the same time allowing the Chevelle to sit lower. The chassis also features Wilwood Pro Spindles, Fox RS-valved coilover shocks, and a 1.25-inch sway bar up front, while the custom rear suspension includes Fox RS-valved coilovers. Baer brakes manage stopping power at all four corners, controlled by a Baer master cylinder and Hydratech boost assist. Weld Racing V-Series wheels give the car a fierce drag race attitude, while a set of Mickey Thompson Sportsman rubber deliver ample traction, especially out back where it's most needed.

The drivetrain consists of a Rodney Craig–prepped 4L80E backed up by an FTI SRL Billet 3,600 stall converter and a Shiftworks ratchet shifter. A QA1 carbon-fiber driveshaft transfers power to a custom U.S. 12 Speed rearend housing with a Strange HD Pro centersection stuffed with an Eaton Truetrac posi, 3.73 gears, and Moser 35-spline axles.

Prior to dropping in the big-horsepower bullet, the U.S. 12 team smoothed the firewall, constructed custom inner fenders, and fabricated a one-off closeout panel to complement the engine's sleek yet intimidating look.

SS

The business center combines a factory feel with modern touches for a high-performance environment. TMI suede and Ultraleather upholstery, installed by the gang at Vos Upholstery, provides a fresh take on the classic-style interior. The stock dash houses updated Dakota Digital gauges to monitor the car's vitals, while a Billet Specialties steering wheel perched on the Ididit steering column adds some additional flair. U.S. 12 Speed installed a 10-point chromoly rollcage for safety, with additional chassis stiffness as a by-product of the exercise. Black DJ Racing harnesses complement the TMI leather bucket seats, blending safety with comfort.

If it's true that red muscle cars carry a rebellious, edgy persona in classic car culture, then John Woods's 1970 Chevelle is guilty as charged. Cloaked in brilliant Glasurit Torch Red, a U.S. 12 Speed custom mix, the car stands out as an absolute troublemaker. Custom touches include nipped and tucked factory bumpers plated by Chrome Race Cars for a brilliant shine. The U.S. 12 crew also extended the rear valance to showcase the custom exhaust notches.

John's takeaway from this three-year gestation: "When building a custom car, patience is crucial. It takes more time and money than you expect, especially as changes and challenges arise. The process took a little longer than I anticipated, but the Chevelle now looks and performs just how I envisioned: a total badass!"

## TECH

**OWNER:** John Woods, Rochester, Michigan
**VEHICLE:** 1970 Chevelle

### Engine

**TYPE:** Dart Big M iron block
**MACHINEWORK & ASSEMBLY:** Steve Morris Engines (Northern Shores, MI)
**DISPLACEMENT:** 540 ci
**COMPRESSION RATIO:** 9.5:1
**BORE:** 4.50
**STROKE:** 4.25
**ROTATING ASSEMBLY:** Callies crankshaft, Oliver steel rods, CP Carillo pistons
**CYLINDER HEADS:** Dart 355 CNC aluminum
**VALVETRAIN:** PAC valvesprings, Jesel SS shaft rockers, Trend Performance pushrods
**CAMSHAFT:** Steve Morris Engineering (specs proprietary)
**INDUCTION:** Shaun's Custom Alloy billet intake manifold
**FUEL INJECTION:** Holley Dominator tuned by Steve Morris, Todd Woods, and Kyle Woods
**POWER ADDER:** Procharger F2 supercharger
**VALVE COVERS:** Billet by Steve Morris Engines
**EXHAUST:** Custom stainless 2 $^{3}/_{8}$-inch headers, custom 3-inch stainless polished exhaust by U.S. 12 Speed and Custom (Buffalo, MI)
**ANCILLARIES:** Taylor wires, Eddie Motorsports hood hinges, PRC Performance aluminum radiator, Meziere billet water pump, Jones Racing alternator, Holley coil-on-plug ignition, Rick's Tanks 27-gallon stainless tank, Aeromotive 5.0 GPH brushless fuel pump
**FLYWHEEL HORSEPOWER:** 1,605 at 19 lbs of boost, 1,495 at 17 lbs of boost
Rear Wheel Horsepower 1,338 at 17 lbs of boost tuned for street

### Drivetrain

**TRANSMISSION:** GM 4L80E by Rodney Craig (New Buffalo, MI)
**TORQUE CONVERTER:** 3,600 stall FTI SRL Billet
**SHIFTER:** Shiftworks ratchet
**DRIVESHAFT:** QA1 carbon fiber
**REAR AXLE:** Custom housing by U.S. 12 Speed, Strange HD, Eaton Truetrac differential, 3.73 gears, Moser 35 spline axles

### Chassis

**CHASSIS:** Roadster Shop SPEC, U.S. 12 Speed modified
**FRONT SUSPENSION:** Wilwood Pro Spindles, RS tubular control arms, Fox RS valved coilover shocks, 1.25-inch sway bar, RS power rack-and-pinion steering
**REAR SUSPENSION:** U.S. 12 Speed long-tunnel, Fox RS valved coilover shocks
**BRAKES:** Baer 13-inch rotors, four-piston calipers, front; Baer, 11-inch rotors, two-piston calipers, rear; Baer Remster master cylinder; Hydratech hydraulic brake assist
**SUSPENSION MODS:** U.S. 12 Speed long-tunnel suspension system

### Wheels & Tires

**WHEELS:** Weld V Series, 17x4 front, 15x11 rear
**TIRES:** Mickey Thompson Sportsman S/R, 28x6 front, 30x13 rear

### Interior

**UPHOLSTERY:** Black TMI suede and Ultraleather, custom black loop carpet
**INSTALLATION:** Vos Upholstery
**SEATS:** TMI
**HARNESS:** DJ Safety five-point
**STEERING:** Ididit column, Billet Specialties steering wheel
**SHIFTER:** Vintage Horseshoe
**INSTRUMENTATION:** Dakota Digital VHX-70-CVL Carbon Fiber Background
**WIRING:** American Auto Wire plus ECU Masters by U.S. 12 Speed
**SOUND SYSTEM:** Retro Auto head unit, Polk Audio amplifiers, Kicker KSC350 3½-inch front speakers, Infinity Kappa 6x9 rear speakers, Rockford Fosgate P300-8P 8-inch sub
**STEREO INSTALLATION:** U.S. 12 Speed
**ROLLCAGE:** 10-point chromoly by U.S. 12 Speed

### Exterior

**BODYWORK & PAINT:** U.S. 12 Speed
**BODY MODIFICATIONS:** Extended rear valance with exhaust notches
**PAINT:** Glasurit Torch Red (custom mix by U.S. 12 Speed)
**FRONT BUMPER:** Narrowed factory
**REAR BUMPER:** Narrowed factory
**PLATING:** Chrome Race Cars (Whites Creek, TN)
**HEADLIGHTS:** Holley Retrobright
**TAILLIGHTS:** LED with factory lens

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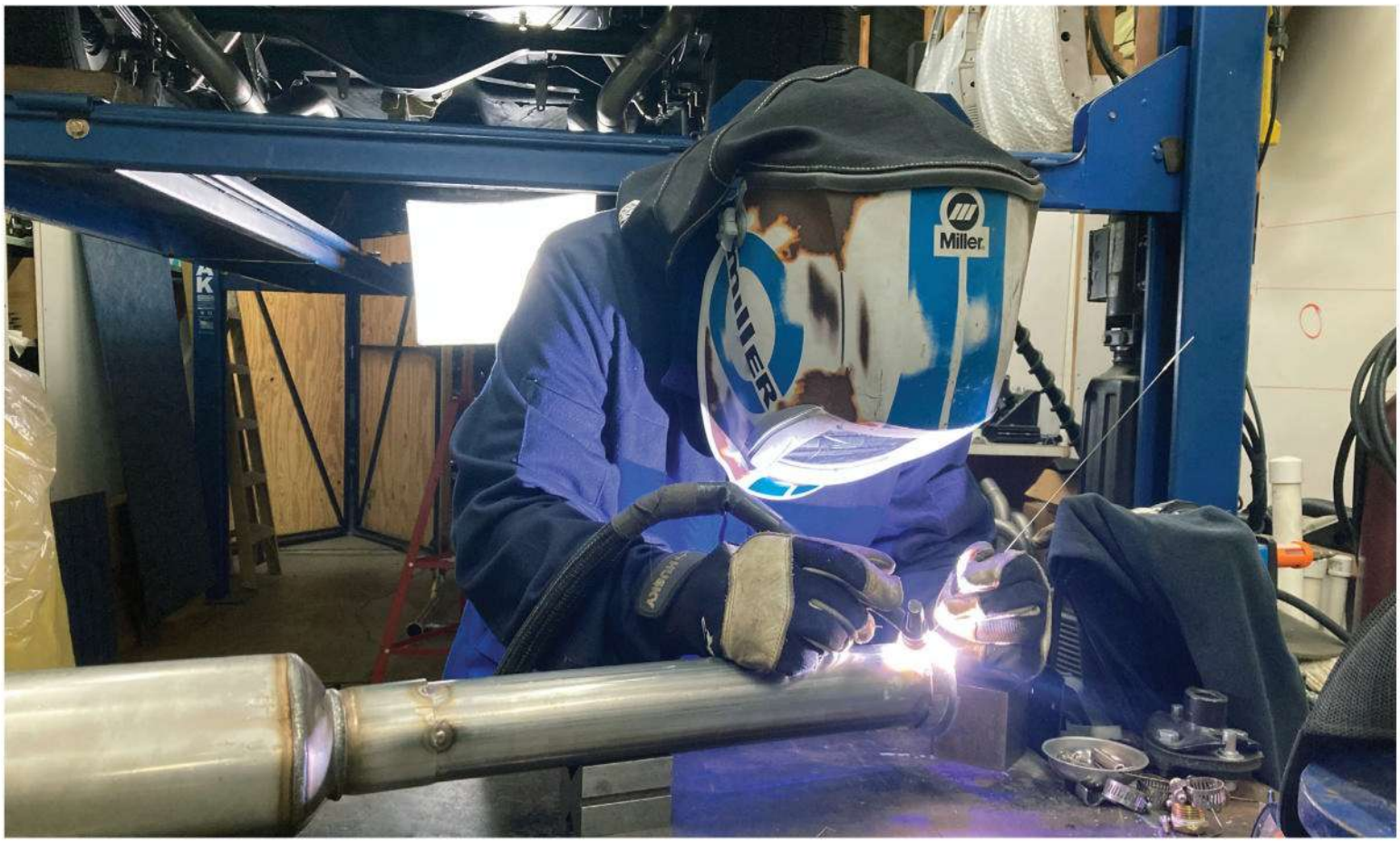



# CUSTOM STAINLESS STEEL EXHAUST

## BACK PURGIN' TO PERFECTION

BY **RYAN MANSON** IMAGES BY **THE AUTHOR**

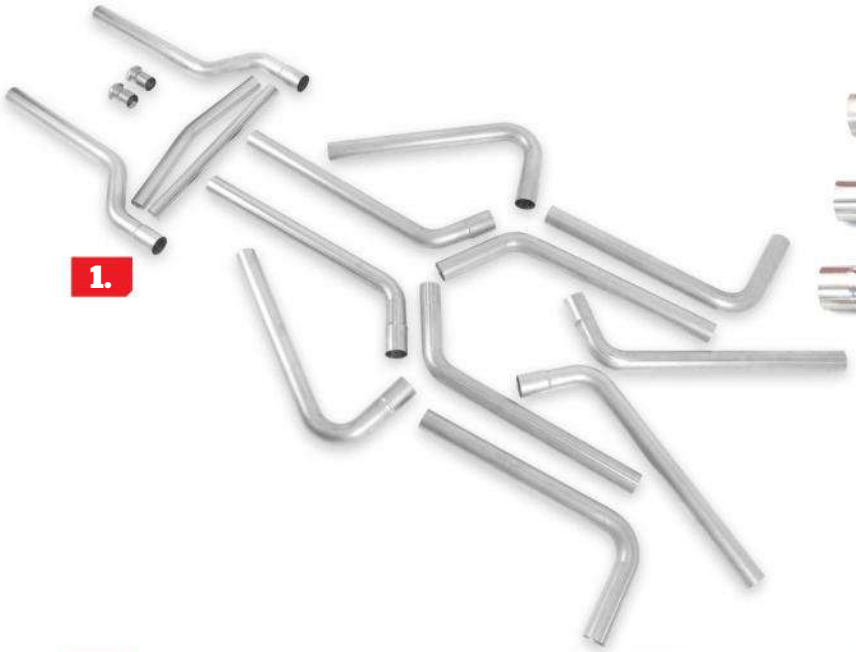
Aluminized exhaust tubing. While it has its place (motorhomes, rat rods, demolition derby cars, and so on), it's not under any self-respecting muscle car, street machine, or restomod build. Back when the only option was to drag your car to the local muffler shop, it made sense to have them whip up a dual-exhaust setup out of aluminized tubing. That was simply the way things were. Today, however, with the availability of affordable welding machines and exhaust kits designed for the DIY guy, it's a lot easier to justify fabricating a custom exhaust system from a more exotic material, like stainless steel.

There are drawbacks, however, to this line of thinking. Many guys don't have the equipment to fabricate such a system or the ability to do so. But if one can TIG weld, read a tape measure, use a level, and retain a level of basic common sense, fabricating one's own stainless exhaust system is not such an abstract idea.

Equipment and abilities aside, there are options for a myriad of muscle cars for complete, bolt-in systems in addition to U-Fab kits, catered more to the advanced TIG-able DIY folks. That 1969 Camaro with an LS swap? There's a very high likelihood that someone makes a bolt-in stainless exhaust kit that can be installed using simple hand tools. But for those of us with an inflated sense of capability and a well-equipped shop, a fully custom stainless exhaust system can be fabricated at home, without expensive benders or exotic tools.

If you've been following the progress of our buddy Bruce Valley's 1957 Chevy Handyman Wagon these past couple months, you'll likely know that things have been progressing fairly well at the Clampdown Competition garage, with the LS swap complete and the suspension components fully sorted. Work has begun on the plumbing side of things, with the brake lines completed and the fuel system following closely behind. As one job gets crossed off the list, another is started, slowly shortening what seemed like an epic saga into a manageable to-do list. Next up? One-off, full-length stainless exhaust using a U-Fit kit and Super HP-2 mufflers from Flowmaster. We've installed a few of these combinations and have been very pleased with the variety of bends provided, the quality of material, and the final sound of the finished exhaust, resulting in a slightly aggressive tone without the bark of a cheap "Turbo" muffler and almost zero drone.

Valley wanted a hot rod vibe to his wagon, and we think this combination will provide just that, while looking just as good as the rest of the car.



**1.** Here at the Clampdown Competition headquarters, we've found that Flowmaster's Stainless Steel U-Fit Exhaust Kits provide a great foundation upon which to build a custom exhaust system. Fabricated from 16-gauge, mandrel-bent 409 stainless tubing, Flowmaster's U-Fit kit features a variety of different bends, allowing the builder to route the exhaust through even the tightest of situations with ease. Their kit also includes adapters and intermediate tubing for H-pipe fabrication. For our LS3 powerplant we're going to go with Flowmaster's 2½-inch-diameter stainless U-Fit kit (PN 815936).

**2.** To help mellow the roar of the LS3, we'll be using a pair of stainless Flowmaster Super HP-2 mufflers (PN 12518304). These offer a moderate tone with great performance benefits found on similar laminar-flow mufflers in a compact size, with a diameter of 4x5 inches and a length of 18 inches. Given the extra-long length of Bruce Valley's Handyman Wagon, we also went ahead and ordered an extra pair of 45-inch stainless steel straight exhaust tubing from Summit Racing (PN SUM-640272), just in case.

**3-5.** With the wagon on our four-post lift, we begin by getting the chassis nice and level both laterally and longitudinally. This ensures that as we fabricate our exhaust, the measurements taken are relative to each other and in the same plane.

**6.** The stock LS3 exhaust manifolds can be a bit of a bear to fit in an older car, making the swap to Summit Racing's Cast Exhaust Manifolds (PN SUM-G9084B) a given. These high-silicone ductile-iron castings feature a Black Ceramic Coating, providing an attractive finish with performance numbers to boot.

**7.** Summit's cast-iron manifolds come with aluminized reducers, so we swapped those out for a pair of JBA Performance 409 stainless steel reducers (PN JBA-1650-1ST). While we could weld the aluminized steel reducers to our stainless tubing using a specific TIG rod, we prefer to keep the material consistent from stem to stern. The JBA reducers feature the same ball and socket sealing and two-bolt arrangement as our manifolds, so they'll bolt right up. They also feature built-in O2 sensor bungs, reducing work on our part. While we were at it, a set of ARP stainless steel bolts (PN ARP-623-1750) were added to our order to secure the exhaust to the manifolds.

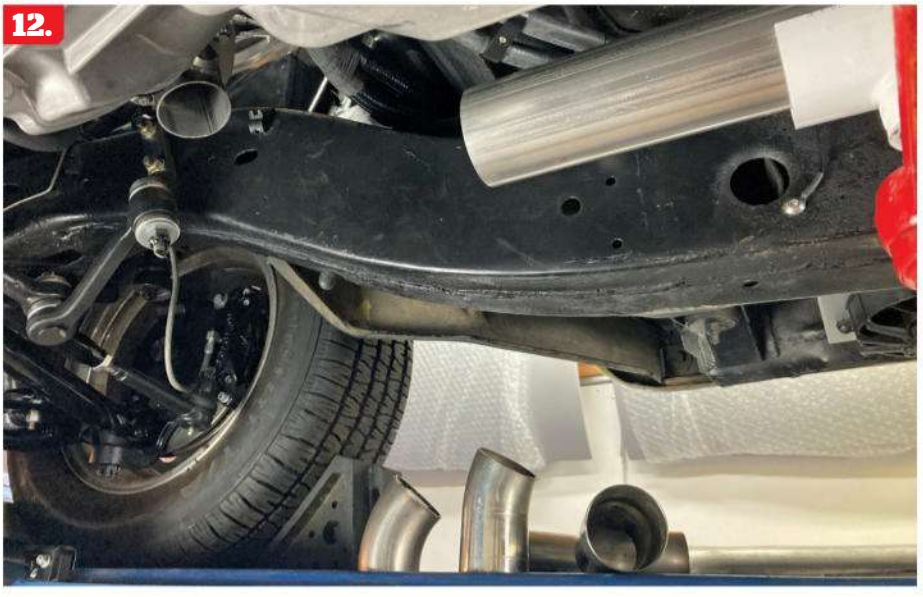
**8.** With our Summit manifolds mated to the LS3 and the JBA reducers in place, we're ready to start our exhaust run. Note the placement of the O2 sensor at a roughly 2 o'clock position. This allows the sensor wires to be run along the back of the engine block and keeps the sensor mounted clear of any moisture that might gather at the bottom of the exhaust pipe.

**9.** The first bend coming off the manifold is going to be rather tight to ensure the exhaust is tucked up above the bottom of the framerail. Here, that tight bend has been test-fit and trimmed a few times before its position is satisfactory. A trio of carefully placed lines marked across the seam of the two sections of tubing help maintain the relationship between the two when the assembly is removed from the vehicle for welding.

**10.** Here's an example of how the two sections are kept aligned while tack welded on the bench.

**11.** Maintaining a tight gap all the way around the tubing can be difficult, especially when there are multiple factors that prevent the sections from simply lying flat on the bench. Here, a magnetic clamp, some parallel shims, and a couple V-blocks help hold things in place while the assembly is tack welded together.

**12.** At this point, we need to turn a corner and start sending the exhaust horizontally down the chassis. Using a pair of pole jackstands, a section of straight tubing is mocked in place at the desired height and a variety of precut bend sections are trial fit.



**13.** We're sneaking up on things here, but the bend on the right still needs a touch of trimming before a short straight section can be used to mate the two sections of tubing.

**14.** With the trimming complete, that short section of straight tubing has been cut to length and the entire assembly tacked together.

**15.** A similar situation transpires on the driver side, with a pair of clamps holding things together while the tack welding is completed. While it can be challenging, at times we prefer to do any tack welding in place on the vehicle so as to prevent any chance of misalignment of the tubing.

**16.** In addition to dodging the steering box, the curved section of both sides of the exhaust also follows the angle of the frame, without dropping below it, keeping the exhaust nice and high, safe from any road hazards.

**17.** The full-length 45-inch straight section of tubing was mocked in place before being tacked to the front curved section coming off each manifold. These will likely get trimmed when we finalize muffler placement. A pair of pole jacks were adjusted until the straight section was plumb with the framerail.

**18.** Viewed from below, the difference in routing between the two sides is fairly obvious as far as the connections at the manifolds are concerned. Each side was treated independently, as needed, to route from the manifold flange to the straight section. That said, the driver side straight section ended up slightly longer than the passenger side.

**19.** As we make our way rearward, care is taken to ensure both sides of the exhaust are level with each other ...

**20.** ... and equidistant to the framerails.

**21.** As previously mentioned, the two sides are not identical in length, and we want to trim them so they are even. To do so, a feature that is present and identical on both sides of the framerail can be used to measure against. Here, we're using a body mount for our reference point, using a level placed square against the end of the tubing to mark the length.

**22-23.** Before we move on, it was decided to fabricate the H-pipe. This helps reduce exhaust droning and increases the efficiency of the exhaust system by equalizing the pressure differences between the left and right cylinders on V-type engines. Once the location of the H-pipe is determined, both sides of the exhaust are removed and a hole punched in both.

**24.** The exhaust is then reinstalled and the length of the straight section can be determined, trimmed, and installed. It was also decided at this point to trim the straight sections just aft of the H-pipe, using this section as the first joint in the system. This will allow the exhaust to be removed in sections if any maintenance is required.

**25.** Stainless steel V-Band Clamps from Summit Racing (PN SUM-694250) will be used at every joint on our exhaust to provide a leak-free union that is easy to assemble and disassemble.

**26.** Here's the first V-Band Clamp in place.

**27.** At this point, it was time to finalize placement of the mufflers. A decent location in which to attach a mounting tab is one of a few factors as to where to place each muffler. Relation to the passenger compartment is another. We've found that locating the mufflers aft of the front seat reduces drone and unwanted exhaust noise from penetrating the interior of most vehicles. Note the fitment made possible from the Super HP-2 muffler's compact size, close but not against the floor, while still well above the bottom of the framerail making ground clearance a non-issue.

**28.** Keeping things nice and level on the bench while tack and final welding is key.

**29.** Due to the extremely tight confines between the wagon's gas tank and the 9-inch Ford rearend, it was decided to run the exhaust under the axle. Not only does the exhaust need to route around the rearend in this area, but it also needs to flare outward in order to clear the tank and trunk floor.

**30.** This was a challenging section to fabricate as we had to deal with multiple different angles, but by supporting each section independently and taking multiple measurements, we were able to assemble two symmetrical sections that provide plenty of clearance to the suspension components while still maintaining plenty of ground clearance.

**31.** A short section taken from a bend is used as an exhaust tip, tucked in nice and tight against the bumper.

**32.** Eye-balling the location of each is possible, but a 4-foot level ensures they end up at the same height and length relative to the vehicle.

**33.** Another V-Band union was added just aft of the muffler, while an additional exhaust mount was also placed near the end of the exhaust.

**34.** The angle-cut turndown tips make for a lowkey exit of the exhaust.

**35.** With the exhaust tacked together, each section is placed on a welding bench and fully TIG welded. Here, the five separate sections are ready for final installation.

**36.** Whatever method you're using to cut your tubing, there's going to be some cleanup involved to get rid of the swarf left behind. We've found a half-round file and a deburring tool handles nearly all of this.

**37.** Cleaning up the area to be welded starts with a scuff using a gray Scotch-Brite pad. This results in a clean, shiny surface, removing most impurities and oxides.

**38.** The inside of the tubing needs to be treated to the same cleaning methods as the outside. A fully penetrating weld will pull any impurities inside the tubing up into the weld creating an unacceptable weld.

**39.** After both the inside and outside have been scrubbed clean using the Scotch-Brite pad, both surfaces are wiped down with Acetone to further clean the surface of any oil, grease, or other impurities.

**40.** While we're at it, might as well wipe down a couple lengths of welding rod to ensure they're nice and clean as well. For this job, we're using ER308L stainless TIG filler wire in 0.045-inch diameter.

**41-45.** Our go-to TIG welder is a Miller Dynasty 210. This inverter machine can handle everything from the thinnest of sheetmetal repairs to chassis fabrication, aluminum, and stainless steel welding. For this job, we'll be welding in the DC setting using the pulse feature of the machine. Using some scrap material, we've found that a pulse setting with a peak of 90 amps, a pulse-per-second of 1.3, 50 percent peak time, and a background amp setting of 25 percent produced the results we were looking for with a fairly small-heat-affected zone and a decent travel time.

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**46.** The stock TIG torch on our Dynasty machine came with a fairly small #7 ($^{7}/_{16}$-inch) nozzle. For mild steel, this setup works fine, given the amount of gas coverage typically required.

**47-48.** Stainless steel, however, likes a larger area of gas coverage, so we've found that a #10 or #12 gas diffuser lens, such as these Fupa units, produce a really nice weld. The larger cup size allows for increased stickout, which results in easier access to tight corners and gives the user a clear, unobstructed view of the weld pool, while the diffuser gas lens allows for higher-cfm gas flow for increased coverage with reduced turbulence.

**49.** Speaking of gas flow, when welding stainless steel tubing, it's necessary to back purge to maintain the purity and cleanliness on the inside of the tubing or backside of weld. This is achieved by purging the interior of the tube with Argon gas, preventing contamination from developing during the welding process. The result is a stronger, fully penetrated weld that isn't prone to failure and cracking. This Dual-Output Argon Flow Meter from Sparc is perfect for back-purging since its dual-adjustability allows for the gas flow to the torch and the back purging source to be set individually.

**50.** When back purging a section of tubing, we try to keep the size of the vessel as small as possible, resulting in less waste of Argon gas. When welding up a large section of tubing, such as a long straight section of exhaust, this can get tricky. Since Argon is heavier than Oxygen, the purge side is usually the lowest point of the section, with the highest point given a small bleed hole for the Argon to push the Oxygen out. Similar to bleeding the air out of a brake system.

**51.** The inside of this weld illustrates why it's important to back purge. Here, we have what's commonly referred to as "sugaring." This is essentially a contaminated back side of the weld. Penetration is questionable, prone to cracking, and typically unacceptable.

**52.** Compared to a section of weld that has been accomplished using the back purge method, we can see a clean weld with sufficient penetration.

**53.** The resulting TIG weld should look something like this, with fairly consistent bead lengths, full coverage, and an even heat-affected zone.

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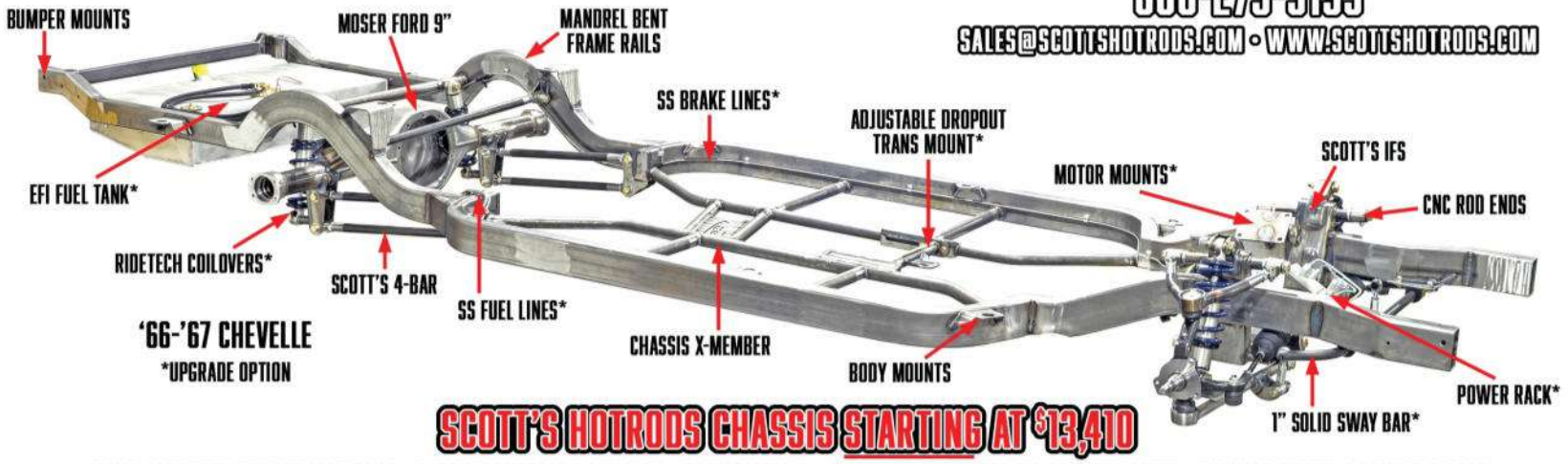


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# HOME SCHOOL

# KEVIN SENSI'S 1969 CAMARO

BY **SCOTTY LACHENAUER** | IMAGES BY **THE AUTHOR**

In the classic car hobby, there are two typical scenarios that revolve around project cars. It's either "I got the money but not the time," or the even more familiar classic "I got the time now, but I ain't got the money." For Kevin Sensi of Springfield, New Jersey, it was the latter situation that set the tone for his latest Camaro build.

So, let's set the record straight, since there are always two sides to every story. Kevin doesn't see his current employment situation as a crutch in any way, shape, or form. "The good news is I've been a stay-at-home dad for the last 15 years, so I get to spend plenty of quality time with the kids. Conversely, the bad news is that I'm a stay-at-home dad, and that job doesn't pay very well! The finances make it tough on my car projects," Kevin says.

In his local muscle car community Kevin is known as a well-schooled muscle car artisan—a wicked wrencher who's been involved in the hobby for nearly 40 years. "I built my first 1969 Camaro when I was 17. It was a Butternut Yellow car I found locally in 1987." Kevin recalls. "Unfortunately, I bought it at night and didn't see all the rust, but somehow I made it all work. It came with a 307 and a Powerglide. That drivetrain didn't last long, as I blew it up after I swapped the intake and carb."

Kevin soon rebuilt the drivetrain starting with a 400ci block and thrashed the Camaro for a few more years, even getting the Chevy down into the mid-11s at the track. However, his ownership didn't last long as life soon took precedent and the car was parted-out and sold in 1992.

Over the years, he often thought about that Camaro. So, nearly three decades later, Kevin decided to do something about those pent-up feelings. "I knew of a basket case 1969 Camaro with a 307 and a Powerglide sitting less than a mile from my house," Kevin recalls. "It took over a year to convince the owner to let it go, but I finally did it. For $1,500 I got a lot of rust and two truck beds of stock parts.

"The plan was to have it done for my 50th birthday, which was two years away. The car was rough, I mean ROUGH, and basically needed everything," Kevin confirms. So, if he was going to make this Camaro rebuild happen, he needed to be able to do everything himself, from fabricating to the mechanicals to bodywork and paint.

Over the course of the next few years, Kevin replaced almost every piece of sheetmetal on the car, excluding the roof and A-pillars. That work included stitching in quarter-panels, a tail panel, doorskins, the firewall, and a new floor. He also replaced the stock rear framerails, moved the leaf springs in 2 inches, and added subframe connectors. He also fabricated a custom chromoly 8.5 certified rollcage.

The subframe was also modified by sectioning the front crossmember and replacing the center with a 2x3 rail to allow the oil pan to be removed without pulling the engine. He then converted the car to a rack-and-pinion setup and added Smith Racecraft upper and lower control arms along with Mencer double-adjustable shocks on all four corners. Out back, Calvert split monoleafs and Caltrac bars help with grip, and the car was mini-tubbed in preparation for the big meats.

Once the metalwork was finished, Kevin went ahead and coated the interior of the car with Lizard Skin. From there, he finished the bodywork and then painted the car in his two-car garage. "It was the first car I ever painted, and it came out pretty good, if I do say so myself."

The power behind this 1969 comes from a 6.0 LS2, built with a forged Eagle crank, Steve Morris pistons, and Molnar Power Adder rods. It's equipped with Chevrolet rectangle port LSA heads, paired with a Texas Speed Titan SR-3 intake, 1,200cc Fic injectors, and a MagnaFuel 4303 pump. Boost is delivered by an FIS 94/104mm 1.32 T-6 turbo along with a Ron Shearer Fab Air to Air intercooler creating a one-two punch that sends the power curve skyward. It was a challenge figuring out where the intercooler was going to go, but he managed to fit 10 pounds of "stuff" in a 5-pound bag! To expel spent fuel and to plumb in the turbo, Kevin used Flowtech headers that were modified for proper fit, along with a custom 5-inch downpipe. Running at a healthy 27 psi of boost, this setup produces an impressive 1,189 hp at the rear wheels.

A Capizzi Automotive–built TH400 with 2.05/1.35 gearset full manual valvebody and trans brake feeds power to an upgraded Speedway Engineering 9-inch stuffed with 3.25 gears.

Wilwood 11.5-inch rotors with four-piston calipers both front and rear help get this beast to a halt. RC Comp Wheels (15x4 front and 15x11 rear, with MacFab double beadlocks) are shod in Hoosier Drag Race bias-ply tires and Mickey Thompson 275 Radial Pros, respectively.

Kevin wired the car from scratch using an ARC relay panel and a Pro Mod switch panel, which made it very easy. A Holley Terminator X runs the car, and to Kevin's surprise it started up on the first try.

The cockpit includes some of the stock Camaro interior pieces, which were made to fit around the 'cage. He added Kirkey Road Race seats and installed a Glasstek fiberglass dash with a Holley 6.86 Pro Dash to keep track of the vitals. A Precision Products shifter gets the Camaro through the gears and a Motion Race Works MPI Race steering wheel on a Woodward column keeps this Chevy pointed in the right direction.

Kevin completed the car a year after his 50th birthday but was ecstatic to see the results of all his work. Unfortunately, on the first drive around the block, the car was rear ended. So back in the garage it went for another round of bodywork and paint.

Once fixed, he hit the track and ran 9.40 e.t.'s at 142 mph on its first outing. The car now goes 8.20 at 165.4 mph while racking up 4,330 street miles at the same time. Kevin ends with this: "I'm proud to have built the car myself instead of just handing it over to a shop with a bag of cash. I like to believe it proves that you can still build a car on a reasonable budget and achieve great results if you put in the effort." ACP

## TECH

**OWNER:** Kevin Sensi, Springfield, New Jersey
**VEHICLE:** 1969 Camaro

### Engine

**TYPE:** LS2
**BLOCK:** Iron 6.0L
**DISPLACEMENT:** 370 ci
**COMPRESSION RATIO:** 9.5:1
**BORE:** 4.030
**STROKE:** 3.62
**CYLINDER HEADS:** Chevrolet rectangle port LSA with stainless valves and dual springs
**ROTATING ASSEMBLY:** Eagle Forged steel crankshaft, Steve Morris CP forged pistons, Molnar Power Adder rods
**VALVETRAIN:** Stock LS7 lifters, stock LS3 rockers with a bronze bushing trunnion upgrade
**CAMSHAFT:** Steve Morris Hydraulic Roller Cam 0.647/0.647 lift, 236/246 duration at 0.050 116+4 degree lobe separation
**INTAKE MANIFOLD:** Texas Speed Titan SR-3 with Fic 1,200cc injectors
**FUEL PUMP:** Magnafuel 4303
**TURBO:** FIS 94mm/104mm 1.32 T-6 with a Ron Shearer Fab Air to Air intercooler
**IGNITION:** Holley Terminator X, stock GM D581 coils, ARC Pro Mod control panel and relay board
**EXHAUST:** Modified Flowtech headers, custom 5-inch down pipe
**OUTPUT** (at crank)**:** 1,189 hp at 27-psi boost
**QUARTER-MILE TIME AND SPEED:** 8.20 e.t.'s at 165.4

### Drivetrain

**TRANSMISSION:** Capizzi Automotive-built TH400 with 2.05/1.35 gearset, full manual valvebody, and trans brake
**CONVERTER:** PTC 9.5 spec by Capizzi Automotive
**DRIVESHAFT:** PST 3.5-inch chromoly
**REAR AXLE:** Speedway Engineering floater, Ford 9-inch, 3.25 gears, 31-spine axles, and spool

### Chassis

**FRONT SUSPENSION:** Stock, front subframe modified for rack-and-pinion steering, Smith Racecraft upper and lower control arms, Mencer double-adjustable shocks, Lowdollar shock sensor
**REAR SUSPENSION:** Calvert split monoleaf springs with Caltrac bars, Mencer double-adjustable shocks, Matt Funkhouser antiroll bar, adjustable Caltrac mounts
**BRAKES:** Wilwood 11.5-inch rotors and four-piston calipers front and rear

### Wheels & Tires

**WHEELS:** RC Comp 15x11 rear with MacFab double beadlocks, 15x4 front
**TIRES:** Mickey Thompson 275 radial pro rear, Hoosier drag race bias-ply front

### Interior

**MATERIAL:** Black vinyl
**DASH:** Fiberglass Glasstek with Holley 6.86 Pro Dash
**SEATS:** Kirkey Intermediate Road Race
**STEERING:** Woodward column
**SHIFTER:** Precision Products
**ROLLCAGE:** 8.50 cert chromoly

### Exterior

**PAINT:** Restoration Shop LeMans Blue
**HOOD:** Glasstek 2-inch cowl

1. Wilwood Engineering's Mike Hamrick *(left)* and Bob Frantino from Eddie Motorsports prepare to install the Heidts Pro-G subframe under the 1972 Nova.

# UPGRADING THE SUSPENSION GAME

## INSTALLING HEIDTS' PRO-G FRONT AND REAR SUSPENSION ON A 1972 NOVA

BY **RON CERIDONO** IMAGES BY **RYAN FOSS**

When the team at Eddie Motorsports set out to build a 1972 Chevy Nova to display at the SEMA show they knew it had to be something special. To that end, they called on Heidts for a suspension update and Wilwood to supply state-of-the-art brakes.

To compete with the Ford Falcon, Chevrolet introduced the Chevy II in 1962. It was available in three trim levels: the 100 series, 300 series, and Nova 400 series. By 1964 the legendary 283 V-8 was offered and when the 327 V-8 became available the following year the little Chevy became a formidable performer.

For the 1966 model year, a restyled second generation of the Chevy II appeared, then in 1968 the third generation that would continue through 1974 was introduced (in 1969 the Chevy II name was dropped in favor of Chevrolet Nova).

The third-generation Nova was completely restyled, had a slightly longer wheelbase than the earlier versions (111 inches compared to 110), and used a unique, bolt-on front subframe that mounted the front suspension, something that had appeared previously on the Camaro. While we're sure GM didn't plan it this way, that removable subframe makes it easy to install a modern aftermarket suspension system, like the Pro-G from Heidts.

Heidts' Pro-G IFS is a complete bolt-on suspension system that features redesigned framerails that allow the use of a 335mm tire (that's 13 inches of rubber). For strength, the control arms are made from DOM (drawn over mandrel) seamless tubing; the uppers are made from 1¼ inch x 0.188 wall tubing, while the lowers measure 1½ inch x 0.156 wall.

Another unique feature of the Pro-G suspension can be found in the spindles as they are considerably different than the commonly used Mustang II style. The Heidts spindles are taller for improved suspension geometry by producing a more linear camber curve during suspension travel, while the raised pin locations (or where the hubs attach) drops ride height by 2 inches. A power rack-and-pinion unit replaces the original steering box, and QA1 coilovers replace the original springs.

In the rear, the Pro-G kit includes a pair of weld-in crossmembers. The front crossmember provides multiple attachment points for the upper control arms that provide suspension tuning options not possible with a normal four-bar system. The rear lower control arms attach to brackets on the axle housing (which also have multiple attachment points) while the front of the arms bolt to the factory leaf spring brackets. The Heidts rear crossmember mounts the Panhard bar and the QA1 coilovers. ACP

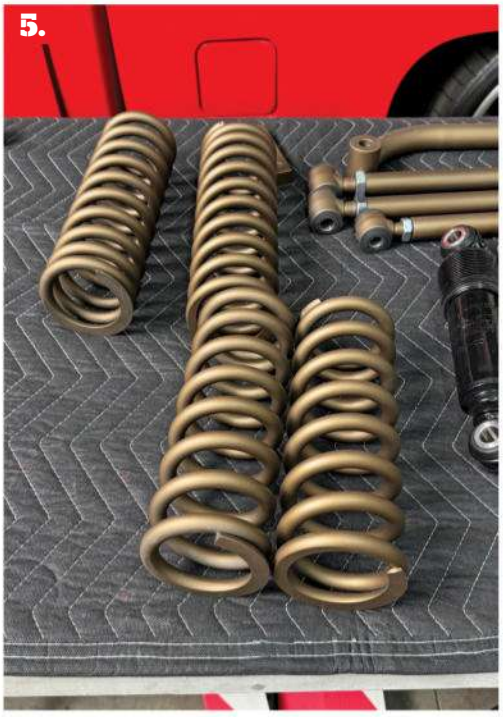
**2.** Heidts' CF-112- 68-74 Pro-G front subframe bolts into 1968-1974 Chevy Novas with no modifications to the car.

**3.** Prior to installation, the subframe and all the suspension components were treated to bronze-colored Cerakote.

**4.** Up front, QA1 single-adjustable coilovers are used. One knob controls both compression and rebound dampening. Turning the knob clockwise will increase both actions of the shock.

**5.** Coilover springs up front are rated at 500 pounds (PN CS19500), while in the rear are 300-pound springs (PN CR-11-B-300).

**6.** The upper front coilover mounts have three positions, which allow fine-tuning of the spring rate.



**7.** Heidts' Pro-G spindle is taller, as the upper ball joint is raised 1½ inches compared to the typical Mustang II style.

**8.** The bolt-on steering arms are secured with Grade 8 bolts. Red thread locker is used during assembly.

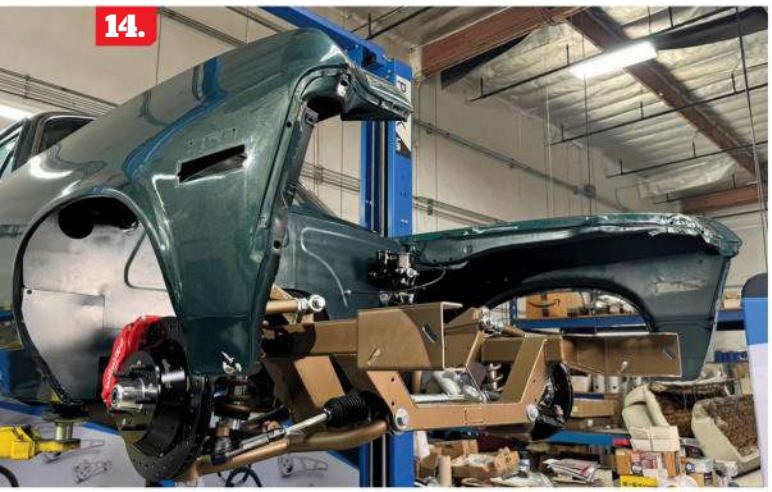
**9.** When installed, the steering arms point to the front of the chassis. The Pro-G dropped spindles lower ride height by 2 inches.

**10.** Included in the Pro-G kit is a power rack-and-pinon steering assembly. Threaded ends on the upper control arms are used to adjust caster and camber (note one engine mount stand is installed on the crossmember).

**11.** The threaded outer tie-rod ends are used to adjust toe when aligning the frontend. Lock nuts are used to secure them and antiseize is used during assembly.

**12.** The fully assembled subframe is ready to be installed. It attaches to the body at the four factory mounting points.

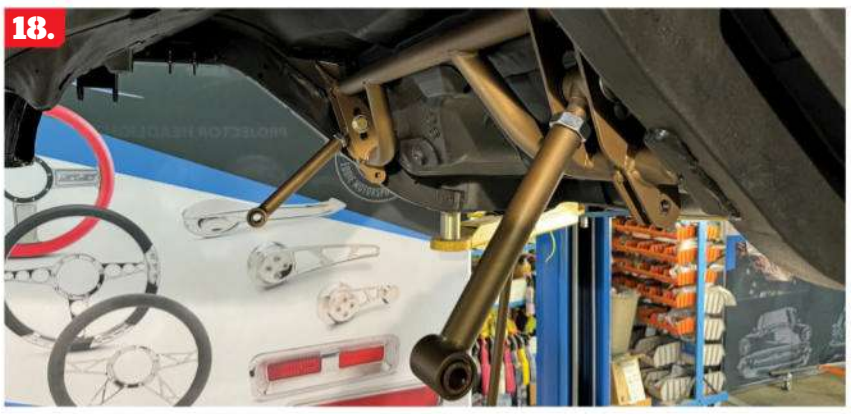
**13.** Included with the kit are new black polyurethane bushings for the sub-frame/body mounts.




**14.** The Pro-G subframe accepts the stock radiator core support; the slotted holes are for the bumper brackets.

**15.** Stopping power is supplied by 13-inch Wilwood brakes on both ends of the chassis.

**16.** The rear axle housing came from Heidts with all the brackets welded in place. The centersection of the Currie 9-inch is equipped with a 3.70:1 ring-and-pinion.




**17.** With the Wilwood parking brake backing plates installed, the Currie 31-spline alloy axles were installed.

**18.** The first step to installing the Heidts rear four-link kit is locating the front upper arm crossmember. It is then welded in place.

**19.** In the rear, the non-adjustable, fixed-valve Heidts coilovers are used.

## HEIDTS PRO-G PARTS LIST:

**IFS**
CF-112- 68-74 Nova PRO-G subframe
CF-560- Pro-G control arm kit with 6 degrees of caster
SP-110- PRO-G spindles
CQ-160- QA1 coilover shocks
OPR-202- power steering rack
MM-300- PRO-G motor stand kit
MM-200- LS engine mount adapters
SB-112-K- PRO-G sway bar (not shown)

**Four-Link**
RC-101-MT- 68-74 Nova mini-tub four-link kit
RC-108- links and hardware
CO-101- standard coil over shocks
CR-300-11-B- 300# springs

There's more to come on the Eddie Motorsports Nova. Next time we'll share some tips on installing the 13-inch Wilwood brakes and advice on choosing a master cylinder.

### SOURCES

**EDDIE MOTORSPORTS**
(888) 813-1293
eddiemotorsports.com

**HEIDTS SUSPENSION SYSTEMS**
(800) 841-8188
heidts.com

**WILWOOD DISC BRAKES**
(805) 388-1188
wilwood.com

**20.** At the rear of the chassis, another Heidts crossmember provides upper mounts for the coilovers and an attachment point for the Panhard bar. This crossmember is also welded in place.

**21.** The Heidts Pro-G rear kit is a true four-link; it provides adjustments of the control arms to accommodate the car's ride height.

**22.** Power will come from a 5.3L GM LS. Those trick Eddie Motorsports rocker covers also conceal the ignition coils.

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BY **TIM KING** | IMAGES BY **MIKE MCCONNELL**

# THIRD TIME'S A CHARM

# JASON NORMAN'S 1971 CHEVELLE

Going from vision to execution doesn't always work as planned. When building a car, you have a vision of how it's going to look, feel, sound, and perform. When it all comes together though, sometimes it's a home run and other times it's back to the drawing board.

Jason Norman had his 1971 Chevelle built, and after getting it back, it wasn't what he had envisioned. The transmission needed to be upgraded and the big-block under the hood wasn't running right. He brought the car down to Epic Rod & Custom in Calgary, Canada, to set things straight.

Sam Hutchins and his crew got busy reworking the transmission tunnel to accept a TREMEC T-56 six-speed and replacing the floorpans. They fixed the electronic fuel injection on the 396 and worked out a few other issues the car had. The car was finished for a second time. Quickly though, Jason's vision of the car changed again, and the car was back under the knife for a third time.

Jason's idea for the car is a 1971 Chevelle SS that looks fairly stock but with all the modern performance and amenities of a modern muscle car. That meant that the big-block had to go, no matter how cool it was. After yanking out the engine, Epic Rod & Custom took the time to completely smooth and refinish the firewall in a semi-flat black. All the extra holes were filled, brackets were hidden, and flush mounted. With that exercise complete, they set in a brand-new GM LSX 454 rated at 627 hp and 586 lb-ft of torque.

Even with a modern engine, Jason envisioned his ride looking traditional. A Holley LS7 single-plane intake was installed to give it that "carbureted" look. They then installed an LS Classic front accessory drive system and their LS big-block valve covers. The cherry on top is the hollow LS Classic distributor in the back with the coils tucked out of the way. Epic Rod & Custom even managed to keep the factory air cleaner housing and cowl induction setup. Finishing off the powerplant is a complete Vintage Air system to keep Jason cool.

Backing the engine is the TREMEC T-56 transmission that started this third iteration. It's coupled with a RAM clutch and pressure plate, surrounded by a Lakewood bellhousing. This setup then sends the power down to a 12-bolt with a Detroit Truetrac differential with Moser axles and 3.90:1 gears.

The stock suspension in Jason's Chevelle was subpar and definitely didn't fit his vision. The frontend was rebuilt with Hotchkis tubular upper and lower control arms and the rear features Edelbrock control arms. QA1 single-adjustable coilovers handle spring and damping duties at each corner.

Finishing off the chassis is a set of American Racing VN501 wheels, 17x9 and 17x10.5 respectively. Wrapping the wheels are Toyo Extensa HP tires, sized 275/40R17 and 315/35R17. Inside all four wheels is a set of powerful 13-inch Baer Pro+ brakes that deliver neck-snapping stopping power.

The interior of the car was left mostly stock with a few subtle upgrades. There's the Vintage Air we mentioned earlier, along with a set of Dakota Digital gauges to keep tabs on that LSX underhood. The rest was restored back to original standards.

SS

COWL INDUCTION

SS
454

SS
Alberta
BZX-B157

The exterior of the car was already done when it came into the hands of Epic Rod & Custom. Jason wanted it as stock appearing as possible, so they left the Metallic White paintjob with black racing stripes. With the theme of the car modern performance, they did install a set of Holley RetroBright Headlights for added safety.

As the old saying goes, "third time's a charm," and it was true for Jason Norman and his 1971 Chevelle SS. With the help of Epic Rod & Customs, his vision finally became a reality.

## TECH

**OWNER:** Jason Norman, Canada
**VEHICLE:** 1971 Chevelle

### Engine

**TYPE:** GM LSX 454
**DISPLACEMENT:** 454 ci
**COMPRESSION RATIO:** 11:1
**BORE:** 4.185 inches
**STROKE:** 4.125 inches
**CYLINDER HEADS:** GM aluminum LS7 70 cc
**ROTATING ASSEMBLY:** Forged steel crankshaft, 4340 forged steel rods, forged aluminum pistons
**CAMSHAFT:** Hydraulic roller (0.648/0.648 lift, 0.236/0.246 duration)
**INDUCTION:** Holley LS7 single plane
**ASSEMBLY:** GM
**ACCESSORY DRIVE SYSTEM:** LS Classic
**EXHAUST:** Ultimate Headers 1.75-inch primary, 3-inch collectors
**ENGINE MANAGEMENT:** Holley Terminator X
**ANCILLARIES:** LS Classic big-block valve covers, LS Classic imitation distributor
**OUTPUT:** 627 hp at 6,300 rpm, 586 lb-ft at 5,100 rpm

### Drivetrain

**TRANSMISSION:** TREMEC T-56 six-speed
**CLUTCH AND PRESSURE PLATE:** RAM
**BELLHOUSING:** Lakewood
**REAR AXLE:** GM 12-bolt; 3.90 gears, Detroit Truetrac, Moser axles

### Chassis

**FRONT SUSPENSION:** Hotchkis tubular upper and lower control arms, QA1 single-adjustable coilover shocks
**REAR SUSPENSION:** Edelbrock rear control arms, QA1 single-adjustable coilover shocks
**BRAKES:** Baer 13-inch Pro+ front and rear

### Wheels & Tires

**WHEELS:** American Racing VN501, 17x9 front, 17x10.5 rear
**TIRES:** Toyo Extensa HP, 275/40R17 front, 315/35R17 rear

### Interior

**UPHOLSTERY:** Refinished stock "SS" interior
**INSTRUMENTATION:** Dakota Digital
**HVAC:** Vintage Air

### Exterior

**BODYWORK & PAINT:** Tom Stafford at Goodfellows Classic Cars (Phoenix, AZ)
**PAINT:** Metallic White with black SS stripes
**HEADLIGHTS:** Holley LED

# THE CAMSHAFT TEST

## WE DYNO TEST TWO DIFFERENT CAMS IN A BIG-INCH BIG-BLOCK TO SEE HOW CAM SIZING CAN AFFECT THE POWER CURVE

BY **JEFF HUNEYCUTT** ◣ IMAGES BY **THE AUTHOR**

If you've been around cars for any length of time, you've probably heard the well-worn aphorism "The camshaft is the brain of the engine," or some version of it.

There is a bit of truth to that since the cam does determine when the valves in the cylinder heads open and close and how quickly, but unlike us smarter individuals—you know, those of us who prefer Chevrolet power over ... well, let's just say another brand—cams really can't make decisions. Variable valve timing is helpful, but once the cam is stabbed in the engine, duration and valve lift really won't change. So, the lesson here is not a matter of how advanced the technology may be in your engine, the cam still needs to be ground correctly for your application.

Of course that's easier said than done. Even the very best engine builders test different cams occasionally just to make sure they are getting the best possible results. When you make changes to an engine package you may also need to update your cam specs.

That brings us to the opportunity that allowed us to tell you this story. Gibbons Motorsports in Mooresville, North Carolina, specializes in high-performance engines. Located in the heart of NASCAR country, they do a lot of oval track racing engines, but their competition engine program includes drag racing, pulling, mud bogging, and just about everything else you can imagine. Of course, they also do high-performance street builds, which is the engine you see here. Brothers Jake and Pete wanted to build a big-inch big-block for Jake's personal C10 Chevy pickup they're building in their spare time.

Originally, the plan was to build an all-aluminum big-block with relatively good power and adequate manners for an old truck. But as with most projects, plans changed and the horsepower potential grew quickly. It all started when the aluminum Brodix block showed up and the brothers found that the bores were larger than what they'd ordered. Of course, what horsepower fanatic is going to turn down the opportunity for more cubic inches? So, they kept the block and ordered up bigger pistons to match, and they ended up with a block sporting 4.600-inch cylinder bores. The crankshaft was already a forged stroker featuring 4.500 inches of movement for the pistons, which made the final displacement a healthy 598 ci.

Then they got a chance to get their hands on a pair of Brodix's 24-degree fully ported cylinder heads and decided they wanted to give those a shot, too. Those heads move air and fuel like a firehose—we're talking 365cc intake ports that flow over 460 cfm, so the intake manifold also needed to be upgraded in order to fully support it. And just like that the relatively mild build (their terms, most regular people would have called the original build plan a monster) turned into a high-rpm screamer capable of exceeding 800 hp on pump gas.

That all sounds awesome, and it is, but the problem was the camshaft had already been spec'd out before all the unplanned upgrades were made. And it was also already sitting on the shelf. Pete and Jake knew the existing cam would be too small for maximum performance with all the revisions to the big-block, but they wanted to try it first and see how the engine responded before deciding just what changes needed to be made for an updated camshaft. And that's how we were able to turn lemons into lemonade and make all of this into a very fun cam test.

Of course, the cam that they had isn't small by any means. It is a 55mm core solid roller from Comp Cams. The cam is ground with 256 degrees of duration for the intake valves and 263 for the exhausts, measured at 0.050 inches of tappet lift. Lobe lift is 0.426 and 0.430 for the intakes and exhausts, respectively. That will make the gross valve lift 0.724 and 0.731 inches. The intake centerline is 110 degrees and lobe separation is 110. Also, the firing order is changed to an LS style, so it will be 1-8-7-2-6-5-4-3.

**1.** The reason we are getting to do this cam test is because of mission creep. When Gibbons Motorsports began planning this big-block engine build it was going to be much milder. But by the time it was done, it had grown significantly in both cubic inches and flow capability. We still tested it with the original cam along with the newer, much bigger cam to see how the differences affected power production, and the results were quite interesting.

**2.** Jake Gibbons, along with his brother Pete, planned and handled the build. This is a personal project that will eventually go into a C10 pickup that Jake is currently building. Originally, we just wanted what he described as a fun, run-around truck. But, typical of performance engine builders, things quickly got out of hand, and we love it.

**3.** Thanks to an aluminum block casting from Brodix with 4.600-inch cylinder bores and a Callies forged crankshaft with 4.500-inch stroke, final displacement will be a healthy 598 ci.

**4.** Although we did have to cut the valve pockets just a touch deeper to accommodate the extra valve lift of the second camshaft, the Gibbons brothers were able to minimize it so that the extra depth didn't change the 10.1:1 compression ratio more than 0.01.

On the dyno the big-block performed well with the first cam, but we could tell there was more to be had. Jake and Pete ran the pull from 3,800 rpm to 6,600. We saw peak numbers of 742.6 lb-ft of torque at 5,200 rpm and 802.7 hp at 6,200. Averages across the pull were 680.2 torque and 676.3 hp. That sounds great, but the power drop-off after peak was a bit precipitous, which told us that the valves were closing too soon and not allowing the engine to breathe properly when it was starting to pick up steam in the upper-rpm range. Given the cubic inches, the flow capability of the cylinder heads and intake, along with the high-flowing Sniper Stealth 4500 throttle body capable of supporting 1,500 hp, this engine was capable of much more.

So, we went back to the drawing board. Pete and Jake worked with their contacts at Comp Cams and came up with an all-new grind. It is still a big 55mm-diameter core, still has the LS firing order, and still a solid roller. But now the duration at 0.050 inch of tappet lift is 271 and 284 (15 and 21 degrees bigger, respectively), lobe lift is increased 0.055 on both lobes to get to 0.481 and 0.485. So, with the same rocker arms, that will make gross valve lift 0.817 and 0.834 (recommended lash has been tightened up from 0.020 to 0.018). Finally, the intake centerline as well as the lobe separation has been moved to 114 degrees, which should help keep overlap manageable.

So, the new cam was installed in our big 598ci big-block and it was put back on the engine dyno. The brothers did have to cut the valve pockets a few thousandths deeper to keep the pistons from crashing into the valves thanks to the extra lift, but otherwise everything was kept the same. By the way, we're burning 93-octane pump gas thanks to the 10.1:1 compression ratio, and the same brand of 15-50 break-in oil was used just to help keep everything the same.

On the dyno the differences were readily apparent even before we were able to make a power pull. Previously, the Holley Sniper Stealth 4500 EFI system had the engine fire up and idle smoothly right from the jump with zero issues. This time around the ECU struggled to get the engine to idle well. That's almost certainly because the bigger cam kept the vacuum levels lower than the threshold for the Sniper system. The Gibbons brothers weren't bothered by this, however. They said it could be handled with a little tuning work. That will be done once the engine is in the truck, and we didn't worry about it on the engine dyno.

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**5.** Both cams are 55mm solid rollers from Comp Cams and use an LS firing order.

**6.** The aluminum cylinder heads from Brodix are fully ported for high-rpm work. The combustion chambers are 119 cc, and the valves sized at 2.350 inches for the intakes and 1.880 for the exhausts. These 365cc intake ports can flow over 460 cfm.

**7.** The shaft-mount Jesel aluminum rockers keep the stock 1.7:1 ratio but are much more stable than pedestal rockers. The same valvesprings were used for both tests.

**8.** A big Dominator-sized Sniper Stealth 4500 was used to provide the fuel. Here, you can see it doing work on the dyno. The Sniper 4500 has eight 100-lb/hr injectors and can handle up to 1,500 hp naturally aspirated. Also, in this photo you can see that Gibbons has upgraded the ignition system to a more modern individual coil setup.

Then we were finally able to make some power pulls, and boy did things wake up! The big-block just continued to pull hard and make power well past the point it had given up previously. But the powerband shifted right on the dyno graph as well. This time around we saw peaks of 731.2 lb-ft of torque at 5,700 rpm (a loss of 11.4) and 863.8 hp at 6,600 rpm. That horsepower gain is an astounding 61.1, and although it isn't exactly apples-to-apples because the rpm ranges are different, averages for both torque and horsepower improved to 688.5 (plus 8.3) and 787.5 (plus 111.2). That's not a typo, the average horsepower improved by a hundo!

This is an astounding improvement, considering the only change was the camshaft. We even kept the same valvesprings for this run, although the increased lift did create greater open pressure and at peak lift the springs were closer to coil bind to help improve damping.

Some might complain that the test of our second cam doesn't match the same rpm range as the test for the first cam. They do have a point, but the Gibbons brothers were more concerned with gaining real-world knowledge that they can use for future builds. They wanted to see the power curve around the peaks. Plus, the more power an engine makes the more damaging it can be to begin the pull too low in the rpm range. That's why you'll never see a dyno pull right from idle. It's because an engine dyno limits the engine's acceleration rate in order to accurately measure torque. In the lower rpm ranges, holding back acceleration at wide-open throttle creates tremendous cylinder pressure that can potentially bend rods and break pistons.

Still, by following the curve of the torque line, you can see that the engine almost certainly still produces torque in the mid 400s at 3,800 rpm—more than enough to spin the tires with a careless stab of the throttle pedal. By 5,500 rpm the second cam had surpassed the first in both power and torque, and it only increased from there. This engine is built for high-rpm performance, so it's obvious that the second cam is the proper choice.

But this is only a single engine build for a specific purpose. What if you are building a big-block but want massive torque at low rpm for towing? Or a small-block with a turbo? Or any other number of builds. Honestly, besides professional engine builders, who can afford to buy a range of camshafts to dyno test which is best? Thankfully, the best cam companies have a wealth of experience on hand to help you determine what cam will work best for you. A high-revving, de-stroked LS6 with ported heads and a fabricated intake may be new to you, but they've probably seen something similar from their many customers a thousand times already.

"The more information you can give us about your car and what you are trying to do, the better," Chris Mays of Comp Cams explains. "We'll start with the big stuff. Are you working on a race car or a street car? Is it naturally aspirated, supercharged, or maybe nitrous assisted?

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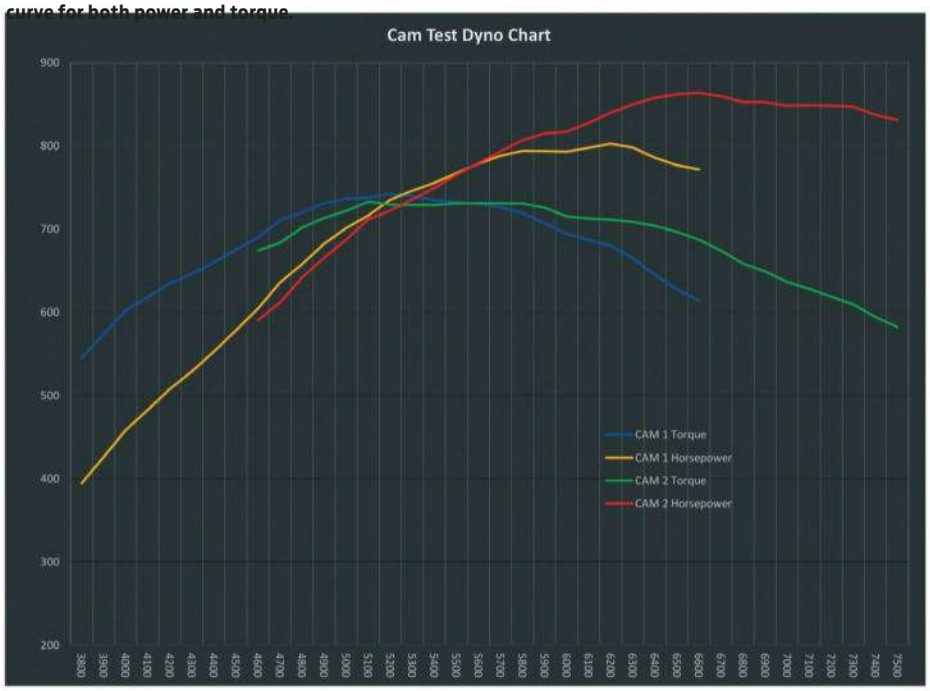
**9.** As you might expect, on the dyno the bigger cam pushed the power curve higher in the rpm range but the results were well worth it. We gained over 60 hp at peak and greatly increased the area under the curve for both power and torque.




"Then we'll drill down from there. What size is the engine? What cylinder heads are you using and how much do they flow? If the car is already built, we'll want to know about that. What rear gear ratio? How heavy is it? If you are running an automatic transmission, what torque converter stall are you running? The more you can tell us the better, then we can take all that information to help you make the best decision on cam choice."

Mays says it is also quite common for him to spend time with a customer trying to improve on a cam choice that was maybe a little bit off. And, by the way, he can't share names, but these are racers on every level. "We have had a lot of success helping customers get the engine response they need by dialing in the cam. Maybe they will say 'It's nosing over on the big end.'

"Well, then we'll look at maybe the lobe separation, is too tight and that's making the torque curve too narrow? Or maybe the exhaust flow is too limited by the port and we can improve it by increasing the duration there?"

Mays points out that cam choice can also help improve mistakes in other areas. As an example, let's say you've rebuilt your engine with a stroker crank and bored out the cylinders to get more cubic inches, but now dollars are tight and you're forced to use the stock heads, which can't flow enough air for the extra cubic inches. You can help that by swapping in a camshaft, which is much cheaper than new heads, with a bit more duration to help get more air and fuel into the combustion chambers.

On the other hand, if your engine is annoyingly weak off the line, you may be able to see improvements by going with a cam that has a shorter duration. That can improve the dynamic compression in the lower-rpm range and help improve the torque right off idle. It's all a game of mixing and matching the many components in an engine to get them all working in harmony. It may be a bit overwhelming at first, but don't worry, you can get there. And don't be afraid to look to the experts for a little help.

"Just tell 'em to give us a call," Mays says. "We'll be happy to help." ACP

## TALE OF THE TAPE

| | CAM #1 | | CAM #2 | |
|---|---|---|---|---|
| | INTAKE | EXHAUST | INTAKE | EXHAUST |
| Lash | 0.02 | 0.02 | 0.018 | 0.018 |
| Duration at 0.020 Tappet Lift | 284 | 293 | 304 | 319 |
| Duration at 0.050 Tappet Lift | 256 | 263 | 271 | 284 |
| Centerline | 110 | | 114 | |
| Lobe Separation | 110 | | 114 | |
| Lobe Lift | 0.426 | 0.43 | 0.481 | 0.485 |
| Gross Valve Lift | 0.724 | 0.731 | 0.817 | 0.824 |

## SOURCES

**COMP CAMS**
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Fits R N D 2 1

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UNIVERSAL FIT

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UNIVERSAL 28-30-32-33" LENGTHS

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EARLY A-F-X BODY 2" DROP

**Stock-Height or 2" Drop Corvette-Style Spindles**

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